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# COMPRESSED AIR

A MONTHLY MAGAZINE DEVOTED TO THE USEFUL APPLICATIONS OF COMPRESSED AIR

Vol. XII AUGUST 1907 No. 6

## COMPRESSED AIR INFORMATION

EDITED BY

**W. L. SAUNDERS, M. Am. Soc. C. E.**

EDITOR OF COMPRESSED AIR

This is a 1200-page volume of the best papers, published from time to time in the magazine COMPRESSED AIR, on the production, transmission, application and practical use of compressed air for every purpose. Its great claim to recognition rests on the practical character of its material, which is compiled from the every-day experience of engineers familiar with the handling of Compressed Air apparatus. The fundamental theory is also presented in clear form. The articles are grouped under proper classification for ready reference, illustrations are freely used, and the work affords a compendium of invaluable information to practical engineers and students of pneumatic science.

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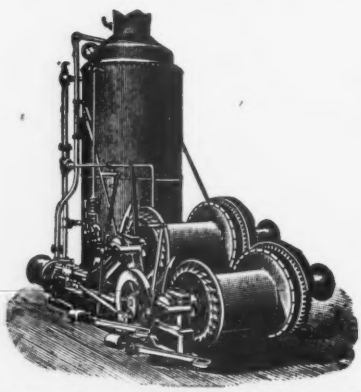

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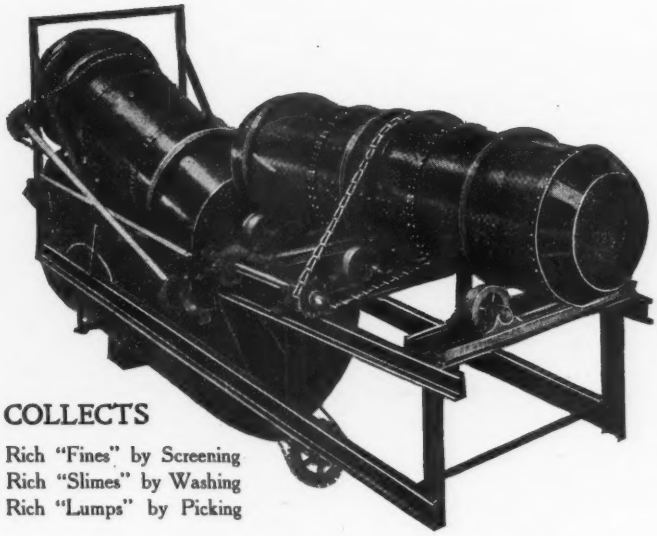

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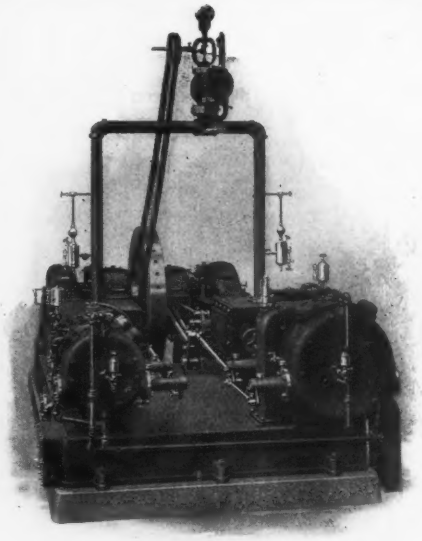

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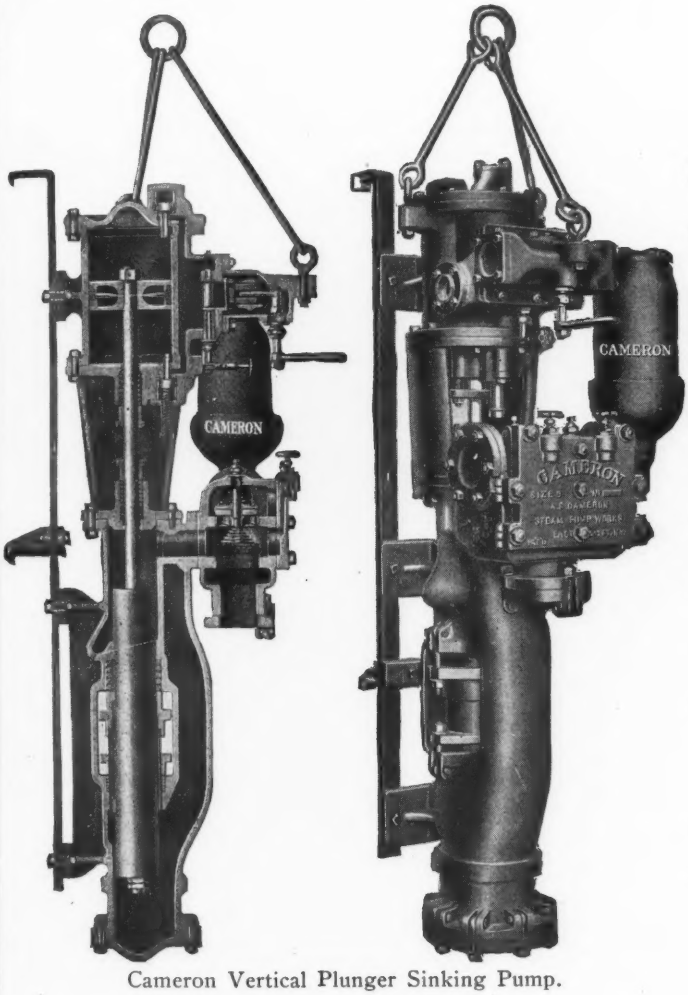


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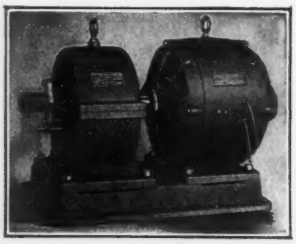

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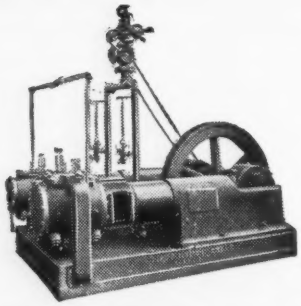

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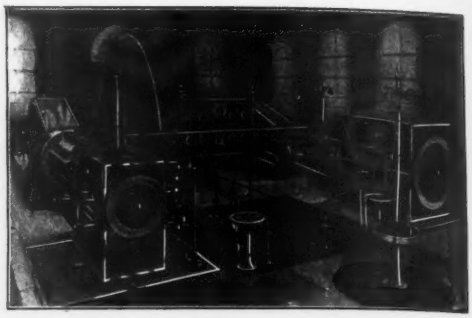

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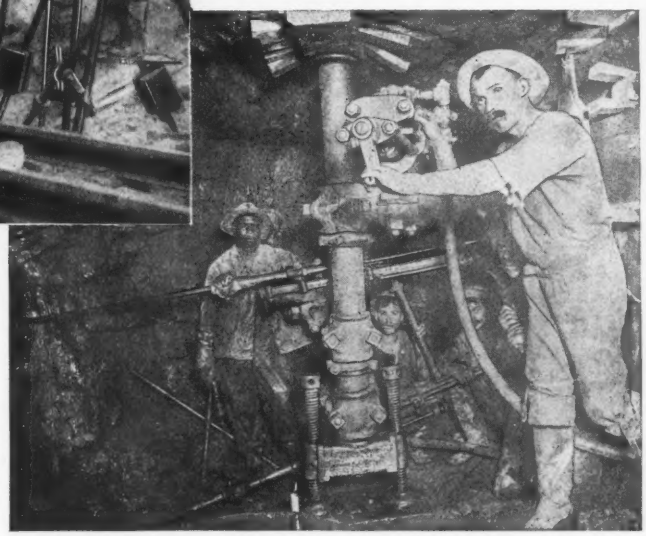

Ingersoll-Rand Drills at work in a tunnel under the East River in New York City. On the subaqueous tunnel work in New York City over **350** Ingersoll-Rand Rock Drills and **93** Ingersoll-Rand Air Compressors are in service.

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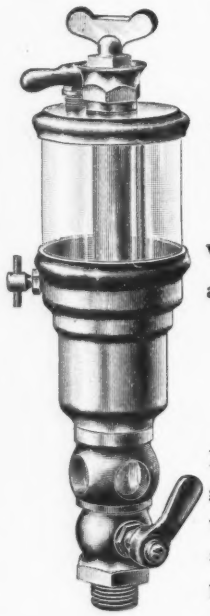

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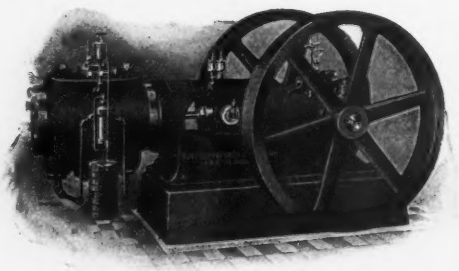

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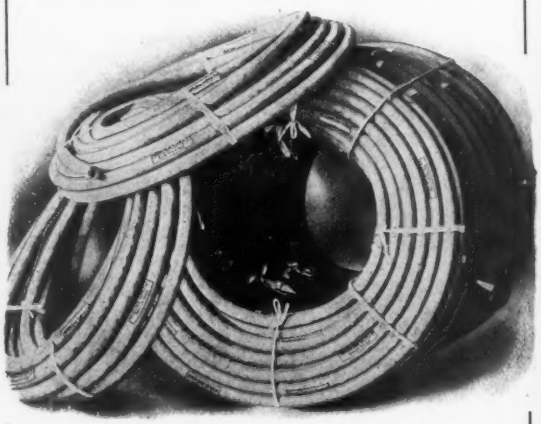

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COMPRESSED AIR

Established 1896.

A monthly magazine devoted to the useful applications of compressed air.

AUGUST, 1907.

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## COMPRESSED AIR FOR STEAM HAMMERS

By Frank Richards.

It is proposed here to consider the economy and expediency of employing compressed air for driving steam hammers and to indicate the conditions under which it is profitable and advisable. If it shall appear to be an *ex parte* plea for compressed air for this purpose it is still believed that the position taken is in strict accord with fact and experience.

The recent suggestion of an engineer of high repute and of large engineering experience that steam hammers "are not successfully operated by compressed air" is, according to my information, as far as possible from the fact. Not only are many steam hammers so operated, but they are always operated with satisfaction if not always with computable economy, and when once air is employed for the purpose its use is rarely abandoned.

It has come in my way to know something of the manufacture of rock drills. These drills are built to be operated some by compressed air and some by steam, and every drill is tested at the factory before it is sent out. This testing operation is much more thorough and exacting than the term suggests. Each drill is run for a considerable time under different conditions of stroke, pressure, etc., until it is found to work correctly under all normal requirements. It happens that all steam drills are tested first of all with air and after that with steam. The invariable experience is that the drill is more lively and operates more satisfactorily in all respects with the air than with steam. After the drill is found to run all right with air it still requires more or less of coaxing or breaking in before it works equally well with steam, the latter being always the more difficult proposition.

The rock drill is only a smaller steam hammer, and the experience with the drill is closely typical of general experience with the hammer. It must be confessed that the use of steam in the steam hammer is never without a number of objectionable accompaniments. We speak now of the hammer as situated not far from the boiler and as supplied with comparatively dry, live steam. The piston or tup is a solid mass, its weight being largely depended upon to give force to the blow, and the cylinder also is much heavier than that of a stationary engine of the same diameter, and when the steam is turned on its first work is to heat up all this weight of metal, thus involving the condensation of a large quantity of steam and the flooding of everything with water. No matter how perfect may be the arrangements for taking care of the water, it still works out of the stuffing boxes, drops around where it is not wanted and is the familiar and constant nuisance of the steam operated hammer. The hammer also is never operated continuously, so that this warming-up and steam condensing operation is repeated

more or less every time the hammer is started. The cost of steam wasted by condensation is quite an appreciable addition to that of the steam employed for the working. There are expansion troubles also connected with the use of steam, the parts not heating up and expanding equally, so that the warming-up process every time the hammer is operated also requires the playing of the hammer up and down, the working of the valves to have them free, etc., and besides the steam consumed considerable time is required. This does not necessarily imply any delay of the work, as the hammer may be got ready beforehand, but it takes the time of a man who might be doing something else.

Steam thus charges continually for waiting in readiness as well as for the actual work it does, while compressed air costs nothing except for work actually done, and this it is always and instantly ready for. The hammer the first thing in the morning is readier to go with full force the instant the air is turned on than it is with steam after fifteen minutes of warming and limbering up, and the same warming up is required more or less every time the hammer is operated.

Another important point is the lubrication of the hammer. With air the oil remains on all the working surfaces the same as with machinery which is all exposed, while with steam the oil disappears almost immediately and lubrication must be almost continuous and requires constant watching. This reliability and constancy of lubrication in the one case and the precarious uncertainty of it in the other is especially brought out in drill testing.

In considering this matter it will appear all the way through that it is not to be settled by merely comparing the costs at the boiler or the power-house. The constant readiness, the handiness and liveliness of operation, the saving of the time of the workers at the hammer, outweigh in each individual case many pounds of coal.

When the hammer is operated at a distance from the source of power, the advantage in the use of the air is more pronounced. A steam pipe is of course losing heat and condensing steam all the way along, and the steam is wet and heavy when it gets to the hammer, while there is practically no loss in the transmission of the air, and absolutely no difference in its working readiness at the hammer.

There was recently a specific case up for consideration in which if steam was used it would be necessary to pipe it 1800 feet. The loss by steam transmission even with costly heat insulation would be quite large for this distance. In the case of the air there might be a fall of pressure of one or two pounds; this loss is easily computable when the conditions are specified, and the loss of pressure would be almost entirely compensated for by the corresponding increase of volume delivered. The loss by leakage, assuming the piping to be properly laid, would be so small as to be entirely negligible.

We give here what data we have immediately available as to the air required for operating a steam hammer. We have information of many plants where steam hammers are driven by compressed air, but in every case some of the air is used for other purposes, so that it is not possible to get the actual air consumption in any given case, and this would be difficult of ascertainment for purposes of comparison in any case, on account of the intermittent use of the hammers and the difference in the total time of employment in each case as compared with any other.

As a starting item we may note the statement of the Niles-Bement-Pond Company that the largest amount of free air required for continuous running of a steam hammer is 26 cubic feet per minute compressed to 90 pounds for each nominal 100 pounds weight of hammer. For hammers used in the ordinary way, or with the average of stoppages, the consumption may be placed at 13 cubic feet per minute.

The cost of compressing to 90 pounds, two stage compression, is about .163 horse-power per cubic foot free air per minute, or for 26 cubic feet, as above, 4.24 horse-power and for 13 cubic feet 2.12 horse-power per 100 pounds of hammer. To operate with steam under conditions similar to this last instance the same authority says that 1 horse-power of boiler capacity should be allowed for each 100 pounds of hammer, the boiler located within a reasonable distance.

The Star Drilling Company, Akron, Ohio, have three hammers with an aggregate weight of 4,200 pounds. At the lowest figure given above these would require $42 \times 13 = 546$ cubic feet, and the horse-power required would be $42 \times 2.12 = 89$. These hammers take care of six fires, and sometimes eight, and are supplied by two compressors whose nominal

(greater than actual) free air capacity is 336 and 296 cubic feet respectively, one-quarter of the air being used for other purposes. We have then 336 + 296 cubic feet = 632 — 177 (one-fourth) = 455 cubic feet, or 90 cubic feet less than the lowest called for by the Niles-Bement-Pond *rule*. The compressors are driven by gas engines using natural gas; the power cost chargeable to the hammers is $52.28 per month.

Of the advantage in the use of air in this plant it is noted as follows:

"The hammers do more work than with steam. There is no trouble in starting to work out the water. Hammers work more lively and freely. No hot water dripping and no additional heat. The air pressure is constant, while with steam there are serious fluctuations and the blows of the hammers are uneven. No steam is used in this plant and the installation is considered more economical and satisfactory with the air."

The main blacksmith shop at the Phillipsburg, N. J., shops of the Ingersoll-Rand Company, the location and arrangement of which, for convenience, efficiency and economy of operation, were given careful consideration, is very near the boiler plant, and the ten or twelve large hammers there are all operated by steam. There is here a Stirling water tube boiler mounted in connection with the reverberatory furnaces to utilize the waste heat, this boiler being connected by an equalizing pipe with the main steam supply pipe of the works. When at times more steam is here generated than is being used by the hammers it goes into the main supply, while when, for instance, most of the hammers are working at once the flow is the other way. Here as elsewhere the difficulty of ascertaining the actual consumption is apparent, but the arrangement in every other respect has been satisfactory.

In the oil tempering and tool dressing shop of the same works, located a little farther from the boilers, there is a hammer of medium size driven by air. This also is satisfactory, and the best arrangement under the conditions.

The air and steam consumption of steam hammers where any records are obtainable vary widely, as might be expected.

The West Manufacturing Company, Buffalo, N. Y., tested a hammer 9" by 15" by actually running it continuously at 150 blows per minute, the air at 80 pounds gauge, and using it at the rate of 230 cubic feet per minute as measured by the piston displacement of the compressor. As a matter of fact, in actual, every-day service, the compressor, running at the capacity above recorded, supplies this hammer, also a 7" by 12" hammer, five large air hoists, twelve small hoists, and a number of live air jets for blowing off scale, etc., and besides that the compressor "unloader," which stops the air compression, is in operation a considerable portion of the time.

The Buffalo Pitts Co. have a two-stage compressor with a nominal capacity of 350 cubic free feet air per minute which ran a 700 pound hammer, 10" by 22", at 150 blows per minute, maintaining 100 pounds pressure. This compressor in actual shop work runs this hammer, a smaller one, an air riveter and a number of smaller pneumatic tools.

The Shiffler Bridge Company, Homestead, Pa., have a two-stage, power-driven compressor with a maximum capacity of about 500 cubic feet of free air per minute which drives two steam hammers, the air being used also for a great number of other purposes, the blacksmith shop with the hammers being a long distance away.

At the Painted Post shops of the Ingersoll-Rand Company there is a 500-pound hammer operated by compressed air, and a 1,000-pound hammer, no longer in use, was so driven. Mr. F. W. Parsons, Superintendent of the Rand shops, writes as follows:

"If the hammers were kept pretty busy doubtless steam would be the most economical of fuel, but, as they are often operated with long waits between, you get with the steam a good deal of condensation and this causes lots of bother when starting up, the iron cooling rapidly while waiting. Unless the packings are very well kept up water of condensation drips on the anvil and forging, which is annoying and sometimes dangerous. Of course with air there is none of this trouble, there is no loss when the hammer is not in operation, and with an equal pressure more work will be done using air than if steam were used. With long and exposed pipes, as are often used for steam to hammers, and especially where the hammers are not kept busy, it is more economical and certainly otherwise more satisfactory to use air."

The Eliott Frog & Switch Company, East St. Louis, Ill., are operating a hammer with compressed air because it is so far from the boilers, and they have an air supply for general

purposes. They find that on account of the condensation of steam, etc., they operate the hammer to better advantage by the use of the air.

There are many railroad shops using air for steam hammers, but we have no available specific information concerning them. We never hear of the air being discarded after being once employed for this purpose, except for other reasons than those immediately pertinent to the hammer service.

The intermittent use of hammers makes a large air receiver capacity desirable, and the reheating of the air is, of course, always promotive of economy. The Trimont Manufacturing Company, Boston, have a 2,000-pound hammer which is supplied with air at 100 pounds by an electric driven, two-stage air compressor of 358 cubic feet capacity, the unloader in this case being in operation about a quarter of the time. There are three air receivers 54 inches diameter by 12 feet long, and the air is reheated by twenty-four 1-inch pipes 2 feet 6 inches long, connected to headers and placed in the hood over the forge fires. The reheating in this case is highly effective, as the exhaust from the hammer is hot to the hand and has considerable unused pressure. The bills for current for this compressor and isolated hammer amount to about $140 per month.

It happens that this Company has also a large steam-operated plant which shows the advantage of aggregation. There are one 5,000-pound hammer, six of 2,000 pounds each and two of 1,000 pounds. The large hammer is used so infrequently that it is assumed to require only the same steam as a 2,000-pound hammer, the aggregate being thus equal to eight 2,000-pound hammers. These are supplied with steam by a 175 horse-power boiler. The coal, labor, etc., are estimated to amount to $35 per horse-power year, the total cost for the year being $175 \times 35 = \$6{,}125$ or $6125 \div 8 = \$765$ for each hammer, or $765 \div 12 = \$63$ per month.

To use air instead of steam no change is required at the hammer. Pipe up as with steam and it is ready at once. Every one likes the air; it keeps the room cooler for the men; there is no water threatening to scald, spattering on the hot forging. Part of the exhaust may be used for blowing the scale off, giving cleaner and smoother work. Only a small amount of air is required for this, as the air is dry and clean. The wear on the hammer itself is invariably in favor of the air, the wet washing out the oil, deranging the packing and causing leakage of piston, valves and stuffing boxes. With air the surfaces polish like glass, remain constantly more or less greasy with little or no wear, and the action is lively and prompt at all times.

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## A STUDY OF WIND PRESSURE ON A MOVING TRAIN

The following suggestive and interesting discussion is contributed to *Engineering*, London, by W. E. Wilson. We present it in a somewhat abridged form:

When there is a strong side wind blowing on express trains it is necessary to burn considerably more coal in order to keep up their speed. The usual explanation is the extra friction produced on the flanges of the wheels by the wind-pressure forcing the train over on the lee-rail. It seems to me that there is a much more potent cause for this retardation, and one which I think has escaped observation. It is the force necessary to accelerate the air which is blowing between each coach and the next. Let us take a typical case where the velocity of the train is 50 miles an hour, and the velocity of the wind 50 miles an hour at right angles to the rails.

Then—

Velocity of train = 4400 feet per minute.

Velocity of wind = 4400 feet per minute.

Let

Area of railway coach end = 8 ft. × 8 ft.

Distance between coaches = 4 ft.

∴ Volume of air passing between each coach and the next per minute = 140,800 cubic feet.

Mass of air passing between each pair of coaches per minute = $140{,}800 \times 0.08 = 11{,}264$ pounds.

$$\therefore \text{Force} = \frac{11{,}264}{32} \times \frac{4400}{60 \times 60}.$$

$$\therefore \text{Work} = \frac{11{,}264}{32} \times \frac{44}{36} \times 4400 = 1{,}892{,}704.$$

$$\therefore \text{H.-P.} = \frac{1{,}892{,}704}{33{,}000} = 57.3.$$

Therefore, in the above typical case the en-

gine would have to develop about 57 horse-power more for each space between the coaches of the train than when the train was run in a calm. Even with quite a moderate wind velocity we could easily get a retardation, due to, say, 10 horse-power per coach, which in a long express train might amount to a total of 20 per cent. of the horse-power of the engine.

It might at first be thought that the theoretical amount of air would not flow between the coaches, but would probably be broken up in eddies. I find by experiment that this is not the case, but that, on the contrary, considerably more air passes between the coaches than we have assumed. Mr. C. Seymour, C. E. of the Midland Great Western Railway of Ireland, has kindly measured for me with an anemometer the wind velocity across the rails and the velocity between the coaches. His figures were:

Observation No. 1, near Longford—Velocity of wind, 350 meters per minute (13 miles an hour); velocity of wind between coaches, 700 meters per minute (26 miles an hour); velocity of train, about 30 miles per hour.

Observation No. 2, near Edgeworthstown—Velocity of wind, 500 meters per minute (18.6 miles an hour); velocity between coaches, 790 meters per minute (29 miles an hour); velocity of train, about 40 miles per hour. The cause of this increase in the wind velocity between the coaches when the train is in motion is, I think, evidently due to the momentum of the mass of air being destroyed on impact against the sides of the coaches, and this must cause a considerable rise of air pressure along the windward side of the train; also, the air which has just passed the front of the train must have its momentum reduced by the advance of the train, which would cause a reduction of pressure along the lee side of the train; this difference of pressure between the windward and lee side would certainly cause an acceleration of the wind between the coaches. This difference of pressure on the sides of the train must be a function of the train's velocity as well as the wind's velocity. If the train is at rest, the pressure is entirely due to the change in direction of the flow of air round the train, and this soon becomes a steady flow; but when the train is in motion it is continuously destroying momentum of fresh air as it advances, and this appears as an increase in the difference of pressure on the side of the train. The same effect can be seen in the efficiency of bilge keels to stop rolling of ships. When the ship is in motion ahead, the bilge keel is always entering the water which is at rest with the ship, and in order to roll she must accelerate this dead water up to the velocity of roll; but when the ship comes to rest, the only available energy she has is the friction of the keels through the water, which is evidently much less than in the former case, when in motion.

## MODERN DEVELOPMENTS IN ENGINEERING RESPONSIBILITY

The following we take from the Presidential Address, by Charles B. Dudley, chemist of the Pennsylvania Railroad, at the Atlantic City meeting of the American Society for Testing Materials:

"It is plain that in using materials in those constructions which involve safety in the railroad sense, or risk of human life in the public sense, there is a question of responsibility involved. If rails are defective and break; if an accident with loss of life results from the use of poor material in car construction; if a bridge falls and produces a disaster due to inferior materials, or a building collapses from the same cause, it is clear that some one should be held responsible. And since there are but two parties involved in the materials—*viz.*, those who make them and those who accept and use them—it is difficult to see how one or the other of them is going to escape the responsibility. Our problem is, Which of the two in equity should be held responsible? It is, perhaps, hardly wise at this time to attempt a definite answer. Much might be said on both sides, and probably no two persons, certainly neither of the two parties most interested, would give the same answer. But there is a phase of the case which we would like to present.

"It is well known that in the earlier structural work, when safety was involved, there was no testing worthy the name, and materials were bought and used on the reputation of the maker. Fortunately, the constructions in most cases had a high factor of safety. When disaster did come, if it was due to defective materials, it was explained that the materials used were from those of the highest reputation in the business, and that no one could really be held responsible.

"At the present time conditions have changed. The knowledge of the properties of materials of construction has increased, meth-

ods of testing and testing appliances have grown up in delightful profusion, and it is today entirely possible, we feel safe in saying, for an engineer to be reasonably sure that defective material does not go into his structures. We waive here the discussion of commercial considerations as affecting the use of materials. If it is shown that these have led to the use of defective materials, the moral responsibility for loss of life must certainly go to the one who has allowed commercial considerations to have such undue weight, be he the maker of the material or the one high in authority who has allowed it to be used. But the point we want to make is, in view of present knowledge and present means and appliances for testing, are engineers or their principals any longer entitled to offer as an excuse for defective materials that they were bought from the best makers? Can they equitably do so? Can they legally do so? Is not the time near at hand when engineers and their principals will be compelled, if not legally, then by force of public opinion, to acquire by the establishment of laboratories and means of testing, by the making and enforcement of specifications, such knowledge in regard to the materials they are putting into structures as will give the public greater security than it now has against disaster?"

## PNEUMATIC INK DISTRIBUTION

The new building of the Baltimore *Sun*, which is electrically operated throughout, has in its equipment two 30 horse-power electrically driven air compressors which maintain a service pressure of 80 pounds. The air is used for pneumatic tube delivery, serving ten stations, for sidewalk freight elevator, etc., but its most important service is for a pneumatic ink distribution, which is one of the notable appliances of the press room. The distributor consists of a reservoir which holds 3,000 pounds of ink and is readily filled by gravity from a platform above it. From the reservoir tubing extends to a conduit the surface of which is adjacent to the ink cylinder of each press. The conduit has a series of openings through which the ink is sprayed by air pressure upon the surface of the ink cylinder. The distribution of the ink is regulated by the speed of the press and the flow shut off when the press ceases its motion. No attendant is required for "inking," as it is done entirely automatically.

## MINE AND TUNNEL VENTILATION

The rate of air flow under a given pressure difference is proportional to the density of specific gravity of the fluid. A pressure of one ounce per square inch will create in the case of water only a sluggish stream, while in the case of air, which is more than a thousand times lighter, the velocity will be a mile a minute. For all purposes of ventilation this pressure and velocity are seldom exceeded and efficiency of movement is to be sought in their reduction to the minimum consistent with the cost of the conduit of greater area.

Ventilation may be readily defined as the replacing of foul air by pure air. The air may be contaminated within by exhalation from the lungs, by dust, by smoke or foul odors, and the system may be designed to withdraw the foul air and force in the pure air—still the result sought is the same. For the plenum or pressure system it may however be exclusively claimed that the air may be made the conveyor of heat and that absolute control may be had over the quality and quantity. The transport of air under such high pressures as obtain in compressor practice must, as a rule, be considered within the field of power transmission rather than of ventilation.

The operation of any ventilating system manifestly depends upon the creation of a pressure difference, which may be produced either by the somewhat crude methods of heating and thereby reducing the density of the air within a vertical flue or by various mechanical means. The former method approaches efficiency only where, as in the case of a chimney, the heat would otherwise be wasted. But even here, since the advent of mechanical draft, simplicity hardly offsets expense where the opportunity is proveded for utilizing the waste heat, as may be done by an economizer. For the movement of air upon a larger scale under moderate pressure the fan blower is the embodiment of efficiency and simplicity. Although the disc and propeller types of fans have a field of usefulness when operated under very low resistance, the centrifugal type of fan has been universally adopted for all general purposes of ventilation, particularly in connection with heating systems.

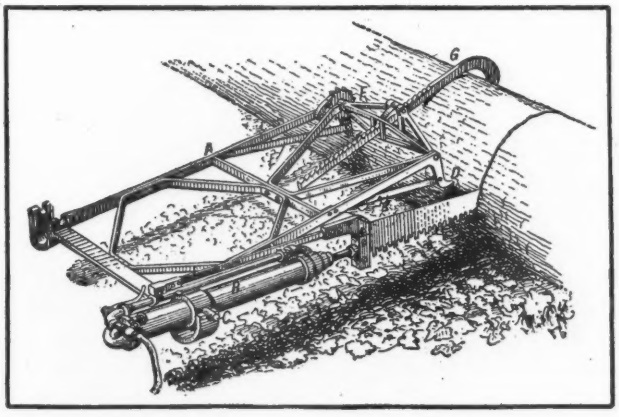
After the completion of the Gallitzin tunnel in the Pennsylvania railroad it was found that great difficulty was experienced on account of the smoke and gases discharged by locomotives.

These caused the atmosphere to become so bad that the trainmen sometimes became unconscious and it was necessary to provide relief. This was done by constructing at the east end a ventilating apparatus consisting of a sheet iron hood about 50 feet long, enclosing one track and having an inner surface coincident with the soffit of the tunnel arch and walls. The outer surface so converged from the outer end of the hood to the portal of the tunnel as to give it a wedge-shaped cross-section. A blower was installed at the end of the hood on each side and delivered air through it to the tunnel portal where a narrow opening in the inner surface of the hood permitted the blast to be forced into the tunnel nearly parallel with its axis.

Trains pass through this tunnel in one direction only, and as the grade is up from this end they are usually drawn by two locomotives in front and one pusher behind. As soon as the forward locomotive enters the tunnel the fan is started. The large volume of air which is forced into the narrow space between the train and the tunnel lining drives the smoke and gas in advance of the locomotive so that its driver can keep the cab windows open and is supplied with an abundance of fresh, pure air. The second locomotive does not work in the tunnel, and the smoke from the pusher never reaches the front of the train. This arrangement is considered efficient and satisfactory.—*Black Diamond.*

## PNEUMATIC LOGGING SAW

The accompanying cut, from the *Scientific American,* shows a compressed air "bucking-up" saw in use on the lands of the McCloud River Lumber Company, Siskiyou County, Cal.




The trees are felled by hand and then are cut into log lengths by this saw. A "swamping" crew precedes the saw and trims the felled trees, throwing the brush to one side to give room for the machines. The equipment consists of a traction engine equipped with an air compressor and air receiver, hose attached giving a working radius of 300 feet. The traction engine is moved under its own power to convenient points, when several trees are within reach. A heavy cross-cut saw is actuated by a piston with a long stroke working in a small cylinder set in a movable frame, which can readily be attached to a log of any diameter. There are usually three of these frames for the one saw. The saw when started is left to work automatically while the two empty frames are being moved to new logs and attached ready to receive the saw.

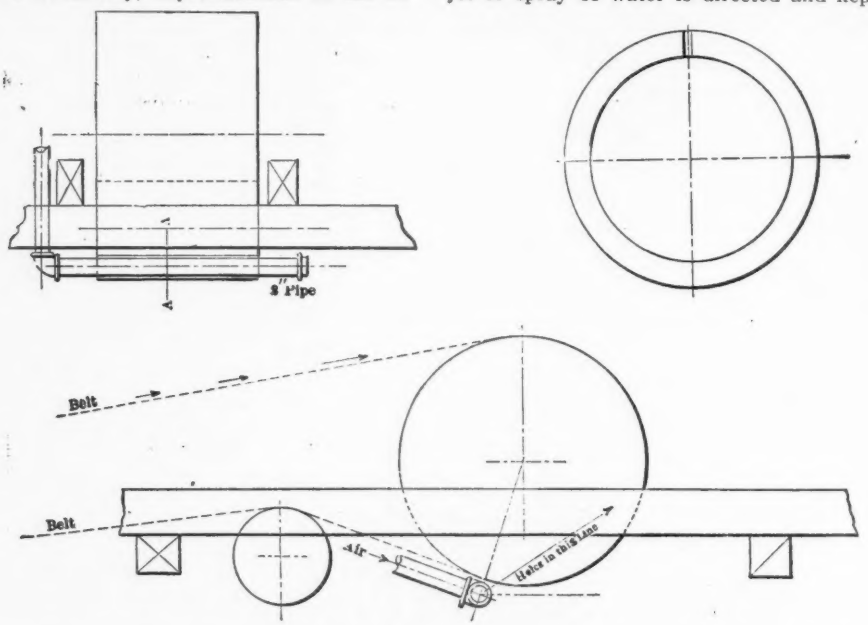
There is economy of time, labor and operating expense in the use of the apparatus. To run it requires nine men, and the average daily cost, exclusive of repairs, is $25. There is no apparent reason why a similar machine should not be used elsewhere when the conditions are favorable.

## MACHINES IN COAL MINING

The report of the Mine Inspector of West Virginia gives some interesting figures concerning the use of machines in coal mining. In 1897 there were 55 machines getting out 600,000 tons—5.12 per cent. of the total output. In 1905 there were 1,158 machines, which got out 10,000,000 tons—32.75 per cent. of the total. The number of employes connected with the operation of the machines increased from 652 to 10,137, averaging about 10 to the machine.

## A DEVICE FOR CLEANING CONVEYOR BELTS

Compressed air for removing wet and sticky materials from belt conveyers has been found effective when the usual method depending upon the use of brushes has failed. The device illustrated in the sketches here shown has for some time been in use at the Cananea Consolidated Copper Company's works at Cananea, Soñora, Mexico, and at the Old Dominion Copper Mining and Smelting Company's plant at Globe, Arizona. As far as known, all credit for the method and its application is due Charles F. Shelby, superintendent of the reduction division of the Cananea Consolidated Copper Company.




The device depends upon the impact of compressed air; the method of application is clearly shown in the sketches. Air under a pressure of 90 pounds is brought to the belt at a point immediately below the return pulley. The pipe is provided with 1/16-inch holes spaced by ½-inch centers, on the side opposite the belt and extending the entire width. The force of the air escaping through the 1/16-inch holes effectually clears the surface of the conveyor.—*Engineering and Mining Journal.*

This device when in use will of course get rid of a lot of air, but it of course is only used a few minutes at a time and at infrequent intervals.

## SUPPRESSION OF DUST IN MINING

In connection with the recent rule issued by the New South Wales Mines Department, compelling the prevention of dust in metalliferous mines, Tyree Ltd., George street, Sydney, are urging the claims of their patent automatic spray. In some instances mine managers have got the idea that their present drills must be displaced by those having water spray attachment; but all that is required by the new rule is that "No hole shall be bored or drilled by machinery underground, unless a jet or spray of water is directed and kept directed into or about the hole, etc." For this purpose the Tyree spray is claimed to be admirably suited, the machine being portable, enabling it to be placed close to the face, or at any distance from it, with pipes to lead to the face. The consumption of water is also very small. The mechanism is simple, consisting of a cylinder containing the water, and a container for the charge of carbide which generates the force which drives the water from a spray nozzle. After the water has been exhausted, the acetylene gas generated in the drum can be used for lighting purposes, so that from the one charge of carbide both spraying and lighting can be accomplished. Besides these two purposes, the Tyree spray can be used for disinfecting the mine.

## SINGLE-ECCENTRIC MEYER VALVE GEAR

By H. V. Haight.

The accompanying drawings illustrate a Meyer valve gear in which both main and cut-off valves are driven from a single eccentric. This gear is used on the steam cylinders of straight-line air compressors.

Referring to Fig. 1, it will be seen that the main valve is driven by pin *C* on the eccentric strap, while the cut-off valves are driven by pin *D* on a rocker, which in turn is driven by pin *B* on the eccentric strap. The rocker is pivoted to the pillow block at *A*. This style of valve gear not only does away with one eccentric, one eccentric strap and one rocker, but it enables all the pins to be supported at both ends and placed so that the bearings are in

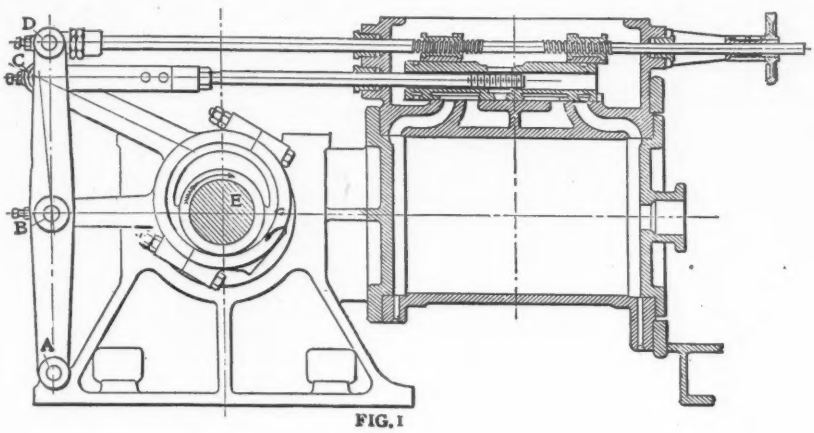



FIG. 1

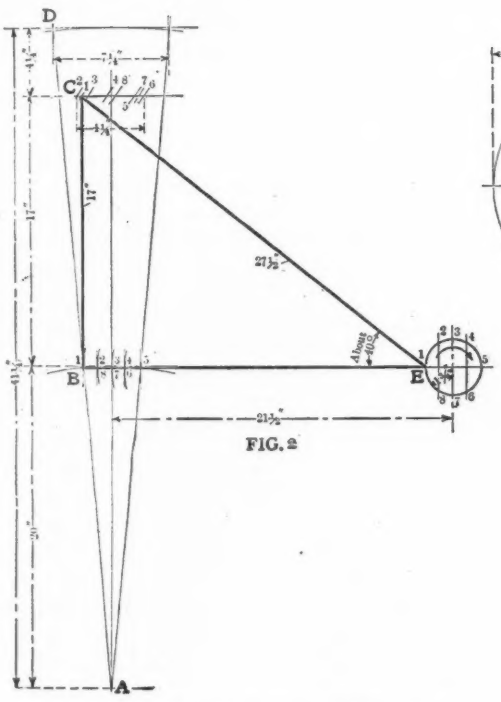



FIG. 2

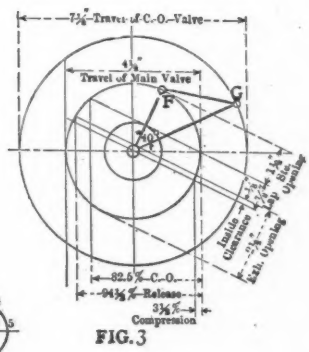



FIG. 3

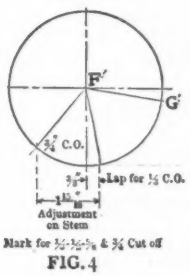



FIG. 4

Single Eccentric Meyer Valve Gear.

direct line with the stresses, and there is no twisting action on the rocker. The cost sheets show this style of valve gear to be cheaper than the ordinary style using two eccentrics and two rockers.

It will be noted that the machine runs "under." In order to make it run "over" it would be necessary to drive the main valve from the rocker and the cut-off valves from the eccentric strap, which makes an awkward construction and does not give as good a valve diagram.

LAYING OUT THE GEAR.

The method of laying out a valve gear of this kind would be about as follows:

In laying out the cylinder, the length of the ports will be made about three-quarters the diameter of the cylinder, and the width will be be made such as to give a velocity of 4000 to 5000 feet per minute. The steam opening will be made about three-quarters of the width of the port. The trial valve diagram for the main valve may then be laid out. For air compressors the valve has no lead and the compression is made small. The point of release will depend somewhat on the piston speed. The inner part of the valve diagram in Fig. 3 shows suitable percentages of cut-off, release and compression for a valve gear for this purpose. Having obtained the travel of the main valve, the next step would be to make the valve-gear layout, Fig. 2. An even figure would probably be chosen for the throw of the eccentric, which might bring the travel of the main valve slightly greater or less than that in the trial valve diagram. The final diagram may now be laid out. The angle between *B*—*E* and *C*—*E*, Fig. 2, gives the angular advance of the virtual cut-off eccentric, while the diameter of the outside circle in Fig. 3 will, of course, be made equal to the travel of the cut-off valves, as shown by Fig. 2.

Fig. 4 is then laid out by making *F'*, *G'* equal and parallel to *F*, *G*. The other positions for *F'*, *G'* are drawn for the minimum and maximum cut-off desired.—*American Machinist.*

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A special meeting of the American Society of Mechanical Engineers will be held in New York, October 8, to act on a proposed merger of the society with the Mechanical Engineers Library Association.

## DEVELOPMENT OF THE AIR BRAKE

None of the safety devices and appliances, as they are in use to-day, sprang "full panoplied" into existence. For example, while the Westinghouse air brake is known wherever a rail has been laid, few may be aware of the fact that, though in certain essentials it is the same device with which George Westinghouse revolutionized train operation nearly forty years ago—it was first used on the Pittsburgh and St. Louis ("Panhandle") Railroad, on the "accommodation" between Pittsburgh and Steubenville, in the year of its invention, 1869—it is as far ahead of the original as are the wonderful achievements of the locomotive builders of to-day in advance of the first railroad engine. Nevertheless, the performances of that first air brake were so satisfactory that its introduction in the passenger service of the various railroads followed almost immediately. First came the "straight air," which had on the locomotive its compressor and reservoir, from which the air was forced, at the will of the engineers, through the "train pipe" of each car and through the lengths of hose that coupled it from car to car, to apply the brakeshoes. Its shortcomings were that the perishable rubber hose was likely to burst, and so render it inoperative; and that, in the case of a parted train, the half to the rearward of the point of separation was left without braking power.

Then followed (1873) the "automatic brake," which, in addition to having a main reservoir on the locomotive, had an auxiliary storage reservoir on each car; it also reversed the actuating process of the "straight air," in that the train pipe was kept filled with air and applied the brakes when the air was permitted to escape, or when it escaped through a "parting" accident to the train. It was quicker and more efficient than the "straight air"; could be operated on either section of a parted train, and put the possible application of the brakes in the hands of train crew and passengers, instead of leaving the entire brake control with the engineer.

The successful performance of the automatic brake on passenger trains suggested to some of the Rocky Mountain railroads the advantages that would be derived from its use on freight trains, particularly on account of the very heavy gradients of the many miles over which their traffic was moved. The early ex-

periments were so highly satisfactory that, by 1886, it practically controlled, in place of hand brakes, all of the freight traffic on the Trans-Missouri railroads.

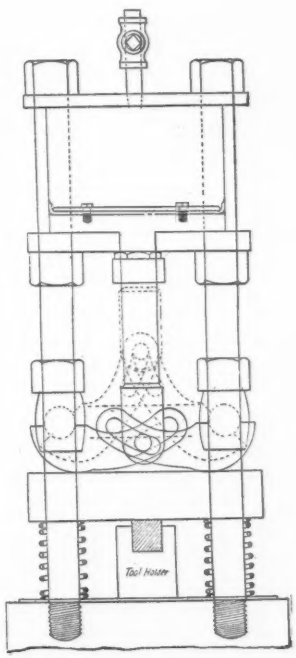
The rapid increase of railway traffic at this period drew attention to this successful experiment, and resulted in the gradual creation of a sentiment that it would be highly advantageous to control all freight trains by power brakes. The matter was placed in the hands of the Master Car Builders' Association for examination and tests, and under its auspices were made what are known as "the Burlington trials."

The performance of the automatic was entirely satisfactory for all ordinary service; but when applied in emergency the front brakes went on so much more quickly and with so much greater force, than those upon the rear of the train as to cause highly objectionable, and, under certain conditions, destructive shocks—the rear portion, weakly braked, running into the front portion. The committee, therefore, recommended that further tests be made, to give the inventors opportunity to overcome the defects. The high speed brake resulted, which within the last few years has been fitted to all of the fast passenger trains, while many roads use it upon all passenger equipment.

With the lengthening of trains, the limitations of the automatic brake, in service work, were found; and it became apparent that some improvement in the direction of securing rapid serial application there, as well as in emergency applications, was a necessity of satisfactory brake operation. After a series of expensive experiments there was finally perfected what is called the Quick Service Brake, because of its capacity for rapid serial application in both "service" and "emergency applications." The result is obtained by substantially the means described in connection with quick-acting brakes; with the new device brakes can be applied, in "service" more quickly on a hundred car train than upon a fifty car train with the automatic type, and the brakes are also applied with substantially equal force on the first and last cars of a long train—which was not the case with the automatic brake, those upon the front portion being applied with somewhat greater force than those upon the rear.—*Warwick S. Carpenter.*

## PNEUMATIC TOOL CLAMP FOR WHEEL LATHE

The modern high-speed steels, modern as dating almost from the present century, with the possibilities of rapid chip-making which they carry, have stimulated the railroad shops to active competition, and some of the best results on record have been made in these shops. It is not easy to make comparisons of actual achievements except upon precisely similar lines of work. It happens that in all railroad shops there is one job which is common to them all, and which affords an excellent opportunity. This is the turning of the tires of locomotive driving wheels, in which there has been more or less of rivalry between the shops and accordingly considerable attention has been paid to the details of the operations involved, with a view to the shortening of the time.




The *Railway Master Mechanic,* from which the accompanying cut was taken, says that the average wheel lathe man consumes from five to six minutes each time that he changes tools, and as it is not unusual to change five times for a pair of wheels, thirty minutes is used in the operation, which is practically lost time. In order to reduce this time as much as pos-

sible, Mr. F. C. Pickard, machine foreman of the Pere Marquette shops, at Grand Rapids, has devised a pneumatic appliance for raising and lowering the tool holder plate on a driving wheel lathe, to take the place of the usual four studs and nuts which are tightened with a wrench.

The device as shown by the illustration consists of a 7½ by 5¼ inch air cylinder, anchored by two stud bolts to the tool column, the piston operating two slotted cams which raise or lower the tool holder plate, according to the position of the piston. When the piston is down, the plate is forced against the tool, holding it firmly in position by air pressure, and when raised to the position as shown by the dotted lines the tool is released and can be freely removed. The coiled springs under the tool plate force it upward when pressure is released. The piston moves the tool holder plate ½ inch.

For a tool rest or holder, a piece of steel 2¼ by 3 inches is used and is slotted lengthwise along the top for receiving a piece of self-hardening steel 1¼ inches square. This not only saves steel, but gives a greater bearing on the tool rest.

By using this appliance, lathe tools can be changed easily in one minute without the exertion required in the usual method, and the trouble resulting from the wrench slipping and studs breaking is entirely avoided.

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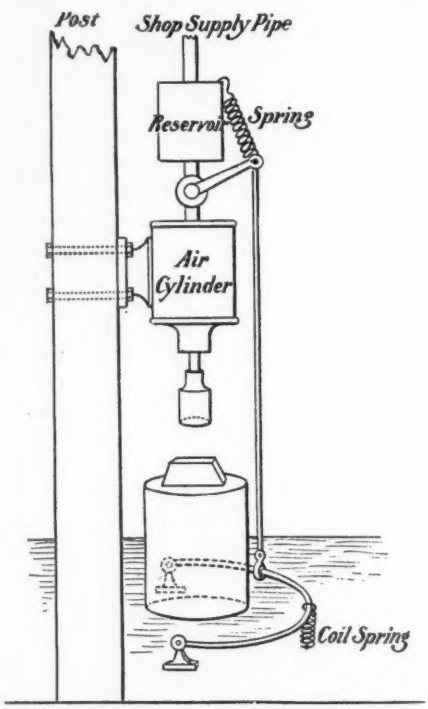
The British Oxygen Company, of London, Birmingham and Manchester, have acquired premises at Newcastle, where they intend shortly to open a branch of their business for the supply of oxygen in the North of England. A large plant for the production of oxygen is now being erected at Newcastle, and it is expected that it will be in operation early in the autumn. The plant will produce oxygen by the liquefaction of air, and it is being constructed under the patents of Dr. Carl von Linde, whose British rights have been acquired by the company. Dr. Linde's process consists of an apparatus in which air is first completely liquefied by his self-intensive system and then, while obtaining almost complete transference of heat from the compressed air entering the apparatus to the liquefied air, the liquid is submitted to a special process of rectification by means of which oxygen of any desired degree of purity can be obtained.

## A CHEAP HOMEMADE AIR-HAMMER

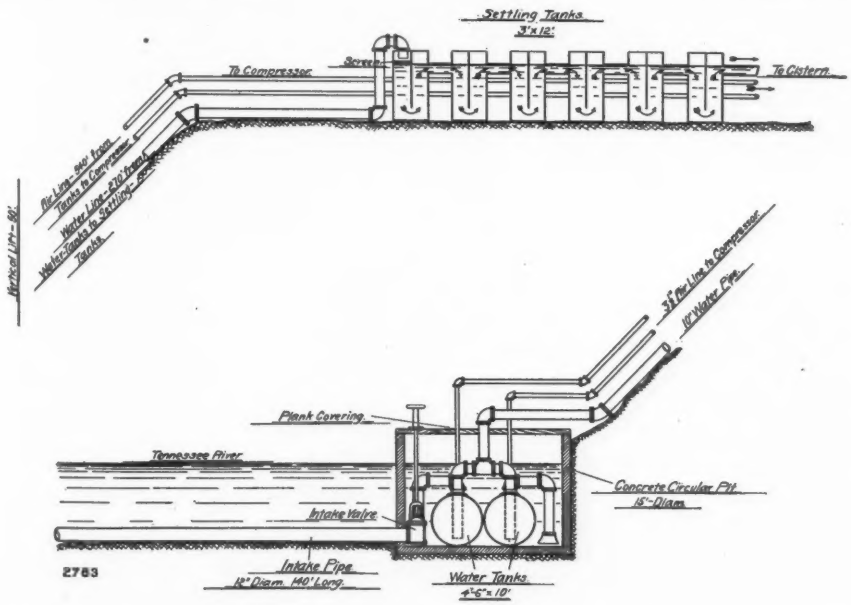
The sketch here reproduced from *Railway and Locomotive Engineering* is an apt illustration of how an enterprising man of the shop who wants to do things is apt to take advantage of the presence of a constant supply of compressed air, and by the aid of simple and inexpensive devices make its readiness and handiness available for many purposes. The hammer was gotten up by Mr. William Gunmere, air brake expert in the Columbus, Ohio, shops of the Hocking Valley Railroad, and the sketch, although so simple, really tells us all about it.

The air cylinder formerly did duty on a locomotive in operating the driving wheel




brakes. It is bolted to a post, as shown, and the lower end of the piston rod is fitted with a round chunky piece of steel for a hammer head. There is a coil spring in the cylinder which normally holds the piston up, as shown. Under the hammer is the anvil, supported on a large, round block of wood like a chopping block in a butcher shop. There is a pipe in the top cylinder head connecting it with the air reservoir and in this pipe is a three-way

plug cock as used in air brake service, to let air into the cylinder or to exhaust it, according as it is moved to the "application" or the "release" position. The feed valve reservoir above has been discarded after years of service on the road. It keeps a sufficient quantity of air close at hand to fill the cylinder quickly without making the shop supply pipe gasp for breath every time the hammer strikes a blow. The lever of the plug cock is connected by a rod to the treadle below. The treadle is made of ¾-inch gas pipe and extending halfway round the block and about 3 inches off the ground, is handy for the operator in any position. The hammer is used largely for straightening brake rods and other crooked material. It is a useful thing in its line and does a lot of work one way and another. We must confess we would have liked it better if it had been piped to have the air lift the hammer as well as to press it down. A thing used only intermittently as this is uses comparatively very little air and is always ready.




## RETURN AIR PUMPING AT CHATTANOOGA

Manufacturing plants, iron mills, tanneries, etc., located near lake or river, usually get their water supplies from these sources by means of direct-acting steam pumps. The distance from boiler to pump is, in most cases, considerable, and the steam pipes are usually exposed. As a result, the steam condensed in the pipe becomes a serious item, increasing the steam consumption charged to the pump and reducing the pump efficiency to a very low figure. This condensed steam, furthermore, is likely to freeze in cold weather, involving trouble and delay, if not actual bursting of the pipes.

The Chattanooga Coal and Iron Company, Chattanooga, Tenn., until recently obtained their water supply for furnaces and other requirements in the mill from the Tennessee River by direct-acting steam pumps. The water in this river is extremely muddy during practically the entire year, offering serious difficulties in keeping the pumps packed. Pumping under these conditions is a very annoying and expensive problem to the company—a fact that is true with other companies similarly situated. The annual maintenance bill for their pumps was something startling. Pistons, piston rods and valves had to be replaced at very short intervals. The company diligently searched the entire market for a better and more efficient method of handling their water supply and fortunately heard of the Return-Air system of the Ingersoll-Rand Company. After close and careful investigation of this system, they concluded, since there are no wearing parts in tanks (which are usually sub-

merged), no separate attendant at the tanks, no separate building required for air compressors and the efficiency of the system high, to give an order for a Return-Air Pumping System.

The capacity of this plant is 1,000 gallons of water per minute. The equipment consists of two Class "RC" air compressors, size 12 and 16 x 16 inch, two switches placed in their main power house, and a set of tanks 4 feet 6 inches x 10 feet, with check valves. Note that compressors and switches are installed in duplicate. The cut shows the location and arrangement of tanks, air and water lines, vertical lift and distance between tanks and compressor and also between tanks and water discharge. As the water passes through the settling tanks the flow is retarded and the dirt in suspension collects at the bottom, thus leaving the water clear as it enters the cistern. From the cistern it is pumped to a stand pipe near the smelters. If the river water was clear it could just as well be pumped direct to the standpipe by the return-air system.

An interesting feature to be noted is that the Tennessee River is subject to rises of 30 to 40 feet; but the system operates with perfect satisfaction, being entirely independent of the submergence. The plant is giving the utmost satisfaction. O. S. SHANTZ.

## PUMPING SAND BY COMPRESSED AIR

A novel and highly successful application of compressed air is found at the plant of the United States Silica Company, Ottawa, Ill., about eighty miles from Chicago. At this point is an immense deposit of silica sand, very fine, almost snow white, and of the best grade for glass-making purposes. The property of this company at this place has been worked for some years and at present the excavation is about 800 feet long, 600 feet wide, and with a maximum depth of about 100 feet.

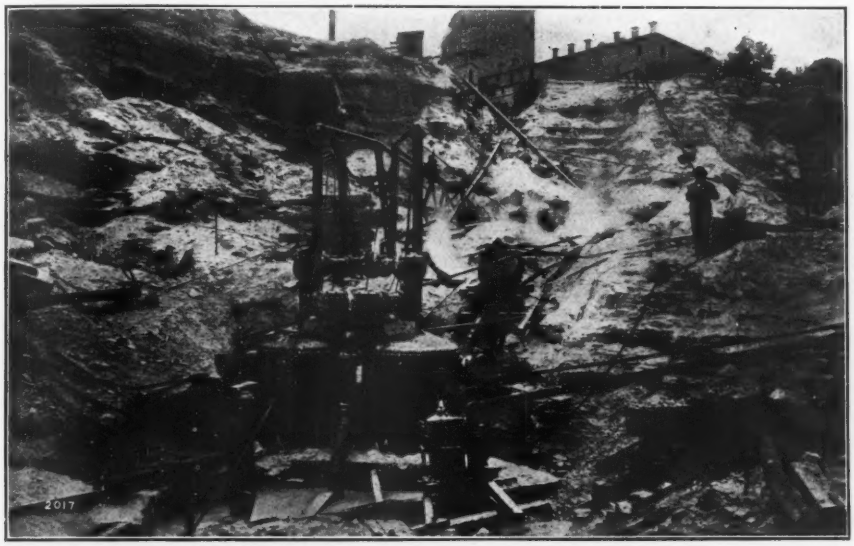
The cost of removing this sand and hoisting to the plant on the surface has been steadily increasing with the depth. Recently a point was reached at which a shut-down of the property seemed imminent unless some more economical method of lifting the sand could be devised. A contract was placed with the Pneumatic Engineering Company, a department of the Ingersoll-Rand Company of New York, for the installation of a Return Air pumping outfit especially adapted for this particular work. This system involves a direct displacement of the contents of a tank by air under pressure, this air being in turn returned to the compressor for re-compression. Advantage is thus taken of the expansive force

GENERAL VIEW OF THE SAND PIT OF THE U. S. SILICA COMPANY, OTTAWA, ILL.

of the air—a feature distinguishing the Harris "return air" system from other pneumatic displacement pumps.

In the Ottawa plant a sump was dug in the lowest part of the sand pit, and here were placed two steel tanks 5 feet in diameter and 5 feet in height. Upon these are mounted the connecting pipes and valves by which the tanks are filled and discharged in alternation. A double air line of 3½-inch pipe leads to the automatic switch and compressor in the engine room on the brink of the pit. The compressor is a Rand, Class "C," straight-line, steam-driven machine, running under 80 pounds steam pressure and delivering air at a pressure of 80 pounds at the maximum of the pumping cycle. The discharge pipe from the pump to the sand bin is a 7-inch pipe and the total distance of delivery is about 400 feet, with a vertical lift of 110 feet.

The method of excavating the sand is at present as follows: A constant flow of water which enters the pit on all sides from springs is collected in a sump which is the source of supply for a small duplex steam pump which takes the water and discharges it through a hose and nozzle. The stream is played on the walls of the pit, washing the sand down, and the mixture of sand and water is directed into a box beside the main pipe. The pump suction pipe enters this box and the partial vacuum created in the tanks draws the sand and water into the tanks, from which it is discharged by compressed air in the next cycle through the delivery pipe to the bin above. The sand mixture varies in quality from one of 5 per cent. of sand to one of 65 per cent., by weight. The average performance of the pump is 50 tons of sand alone raised per hour, or 500 tons of sand per ten-hour day. The work done by the pump will be further appreciated when it is considered that the supply of water entering from the springs is from 300 to 500 gallons per minute, all of which, also is discharged with the sand through the pump.




THE HARRIS PUMP AT THE U. S. SILICA COMPANY'S PLANT, OTTAWA, ILL.

It might naturally be expected that the rapid pumping of such an abrasive material as sand would soon destroy the pump mechanism; but after an operation of several months there has been found to be no appreciable wear on this system. On top of each tank there is a check valve preventing the return of the material in the discharge pipe. This is of the simplest form, consisting of a rubber-covered ball resting on a ring seat; and inspection has shown that while the seats have worn uniformly and present the appearance of highly polished turned rings, the balls themselves show no wear whatever. The pressure-controlling valves are located in the engine room above, and at no time are in contact with the material pumped.

This system works continuously; during the day it pumps sand and water in mixture; during the night it pumps water alone, keeping the pit empty and ready for resumption of operations on the following day. It is found that the maximum volume of water entering the pit can be handled when the pump tanks are filled and emptied at the rate of about one a minute.

The introduction of this method of pumping simplified the problem of removing the sand in many ways. Its operation calls for three men: the engineer looking after the compressor, who also cares for other machinery in the surface plant; the pump attendant, whose duty it is to see that the flow of sand and water is properly directed to the gathering box; and the hose man handling the stream of water for removing the sand from the walls.

The sand mixture is discharged from the pump into the receiving bin at the surface, where it is allowed to settle; the water flows off through a waste-way. This partially dried sand is then removed from the bins and put through the usual process of drying and separating. The operation of the surface plant offers no unusual features; but the introduction of this pneumatic system of pumping in the pit has been the solution of a serious problem which was confronting all the sand producers of that section. The illustration shows the interior of the pit with the pump in position and the pipe lines leading to the plant on the brink.

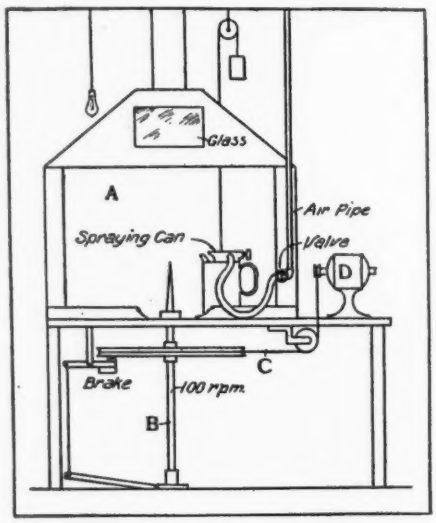
The system which the new method replaces was, briefly, as follows. The work was carried on in three levels. The sand was washed by the hose to the lowest level, or sump, where it was hoisted by a vacuum steam pump to the second level. Here a single outside-packed direct plunger pump lifted it to the third level, from which it was elevated by a scraper conveyor to the bins. The seepage water was handled at night by a duplex steam pump.

All of these pumps were supplied from the surface boiler plant through long steam lines, and the steam and fuel consumption was enormous, due both to the excessive pipe condensation and to the wasteful non-expansive features of the pumps. Furthermore, the whole system was liable to freeze up solid in winter. The depreciation on the machinery involved was very heavy, the plunger pump especially wearing rapidly under the abrasive action of the sand mixture and losing what little efficiency it had. Fuel and maintenance costs were enormous.

With the pneumatic sand lift the only long steam line is the small one to the hose pump. The rest of the system, being under pressure, is proof against freezing, and its freedom from abrasion has already been noted.—*Lucius I. Wightman.*

## COMPRESSED AIR JAPANNING MACHINE

This machine could probably be used to advantage in any factory where japanning is done, as by its use twice as much work can be turned out and many articles can be given a more even coat than is possible by the dipping process, or by hand work. It is especially useful for round work but can be used for any article not too large.

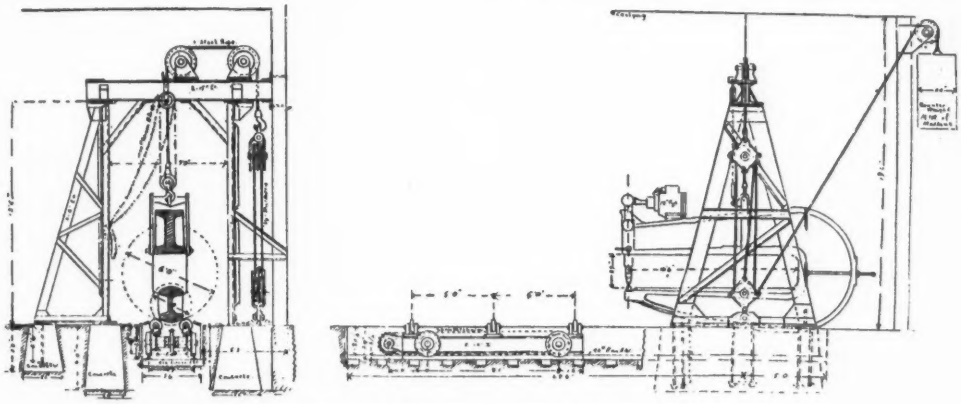



A wooden hood A is left open at the front, and is provided with a pipe at the top to carry away the fumes. Four glass windows are made in the top, and one or more electric lights are arranged so as to illuminate the work. A vertical shaft, B, is revolved by means of a cord, C, which runs to an electric motor, D. The shaft is pointed at the top to receive a flat piece of wood for holding the work, nails being driven in the wood to accomplish this purpose.

As the work revolves it is given a coat of japan, by means of the spraying can, which contains the japan and is connected to an air hose, as shown. These cans can be purchased

ready to use, and are provided with a special compressed air nozzle, which atomizes the japan and deposits it on the work. The japan used for this purpose should be thinned with turpentine before using, as it would otherwise make an uneven coat.

The machine should never run more than 100 r. p. m., and unless the work is very small 80 r. p. m. would be better. If it is run too fast the japan will be thrown off the work by centrifugal force. About 30 pounds air pressure is sufficient, but a greater pressure may be used by throttling down with the valve.



END AND SIDE ELEVATIONS.—HORIZONTAL RIVETER

## A NEW COMPRESSED AIR RIVETER.

The necessity of a large riveting machine is felt in every shop where boiler and structural work is handled. The vertical riveter is a satisfactory installation for all classes of work but is expensive on account of the special building and accessories that are required.

With the idea of furnishing a riveter with the capacity of the vertical type and without the excessive cost, the Albree Iron Works Company, Allegheny, Pa., have recently employed a new method of installation with considerable success.

A compression riveter with 10 feet 6 inches reach is suspended from a wooden trestle 13 feet 6 inches high by a 1 inch steel rope over two sheaves to a block, and falls balanced by a counter weight. A heavy chain and block are within easy reach of the operator for shifting the position of the riveter.

Beneath the riveter, a pit is located 24 inches deep and 29 feet 6 inches long, in which is laid a track of 2 feet 9 inches gauge. On this track is placed a steel car with a sprocket wheel and chain for moving the car when carrying heavy loads. Three rollers are placed on each side of the car to support cylindrical boiler shells.

The method described will cost about one-fourth that of a complete hydraulic installation and about one-half of a vertical compression riveter for doing the same class of work. There is also a considerable saving by using compressed air instead of hydraulic power, and while there still exists a preference for the hydraulic riveter it has been found that the work is not superior to that of the machine operated by air.

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Twenty-five years ago the United States produced 27,000 tons of copper. The production during 1905 was practically 400,000 tons, or more than half of the world's total supply. The value of last year's output may be given as $160,000,000.

The uses of this metal are steadily growing. It is estimated that by 1920 the requirements of the world will reach 1,500,000 tons. The United States will probably hold its present place in the market. New deposits are opened from time to time. There are known districts yet undeveloped in the Western mountains, and Alaska is rich in copper. Mexico and Canada are copper countries and send the United States ore and matte for smelting, and pigs, bars and ingots for manufacture.

The increasing supply of the metal promises to keep prices within reasonable bounds, while the increasing demand fairly assures ample profits to the owners of copper properties.

## THE GORDON DRILL ON THE RAND

The most notable event of recent years in the history of mining operations on the "Rand" in South Africa has been the advent of the Gordon rock-drill. This region has its peculiar labor, or, rather, race, troubles, and the drill is remarkable not only in itself as an invention, but also in the simplification of the task of operating it. The following very clear account of this drill, its operation and status, is taken from recent Consular Reports:

"The Gordon drill, lately introduced on the Rand, has been designed primarily for the saving of labor. Under present conditions, a boy —*i. e.*, Kaffir—puts in one 3-foot hole in a shift in the ordinary manner; whereas, by using this drill he can put in five holes. The drill is so designed that it can be operated in very narrow stopes, thereby saving the mining, tramming, hoisting, milling and cyaniding, etc., of much waste rock. For instance, should a reef be one foot thick, and, through lack of sufficient labor, the mine management is obliged to put in large drills for mining the reef, it is impossible to break a stope of less than from four to five feet. Under these conditions, the rock has a value of about 10 pennyweights; with the use of the Gordon drill the value of this rock or ore is greatly increased.

"It is anticipated that this machine will do away with 75 per cent. of the number of boys now necessary. The saving in cost is problematical as yet, but a conservative figure is 24 cents per ton for the 1,500,000 tons mined monthly, one-half of which amount is at present machine-drill mined.

"In appearance the drill resembles a piece of 3-inch pipe with a crank handle attached. It weighs about 55 pounds. Its cost of maintenance is slightly less than that of a 3¼-inch slugger machine. It drills a 36-inch hole in less than 30 minutes, including time required in changing steels. In the hands of a Kaffir or Chinaman, one machine will drill four to six holes, 36 inches deep, per shift; one white man is necessary for pointing, charging and firing the holes for five machines.

"The drill is fed forward against the rock face or bottom of the hole drilled, by air pressure, and hence needs no screw-feeding or shell. It moistens and ejects its rock cuttings automatically, without creating any dust whatever. It has no chuck bolts, the steel being loosely positioned in the chuck. It is encased in a 3-inch pipe and can not be tampered with by the Kaffir. It can be worked in as small a stope as a boy or Kaffir may crawl into.

"The machine is made of steel throughout; the column and arm with clamps weigh about 70 pounds and can be easily carried about and set up in about five minutes. It has no bolts nor nuts, simply wedges, so driven that they can not fall out when the machine is in use. Instead of a wrench, a hammer is used to tighten the parts. The clamps on the arm are of advantage in giving the drill a longitudinal movement of 17 inches in addition to the 12-inch travel of the machine, affording a forward or backward movement of 29 inches, and thereby doing away with the necessity of taking down and setting up of the column every second hole. The air hose is one-half the size ordinarily used, weighing only 30 pounds as compared with the 75 pounds for the 3¼-inch sluggers.

"The steel is forged to cruciform shape bits, and it is therefore impossible for the Kaffir to drill other than a round and straight hole, even when the ground is very seamy. Four steels are used to each 3-foot hole. The steel-dressing machine used in sharpening the bits will point 400 steels per day at the same or less cost than for a like number of 3¼-inch machine drills. The ordinary dirty and acidulated mine water is used in operating the drill, the head of which only is in the drive line; the consumption of water is about 1½ gallons for each 3-foot hole drilled. The reef air pressure of 70 pounds is acceptable.

"The white miner requires no knowledge of drills, but should understand how to break ground; the Kaffir or Chinaman is required only to change steels every few minutes, open and close the air-valve on the machine and turn the crank handle, none of which duties require any great intelligence on his part.

"Hollow steel is used, and the water is forced through the hole under a head of 50 feet, which is sufficient for keeping down all dust. In starting a hole, a 1½-inch bit is used, which is followed by bits of ⅛-inch less diameter, until the hole is bottomed out with a 1-inch bit. The drill strikes 400 to 500 blows per minute, with strokes varying from 7 to 8 inches."

The following from *South African Mines* gives an account of a series of trials of the Gordon drill, and in connection therewith it

tells of the development and practical improvement of the drill since the first crude specimens of it were put out:

"The Robinson trials of the Gordon drill, extending over a period of eight months, have developed the weak points of the machine, particularly in relation to material and workmanship. When the fifteen machines were first put to use on the Robinson they were not equipped with many of the features they now have. The features referred to are the automatic oiling arrangement, ratcheting crank handle for 2-foot stopes, improved water front head, etc. These parts were made locally, and unfortunately both the material and workmanship were not what they might have been. Properly made at home they will prove above criticism. Among the so-called weak points we find that the cylinders are made of mild instead of cast steel. True, the wear in six months is only one two-hundredth part of an inch; still, if the hard cast steel were used it would be practically nothing. On the other hand, the wear of big machine drill cylinders is five to ten times as great in the same period. Again, we find two pieces pressed together and riveted, whereas the better method, and that now employed, would have been to make the two pieces out of a solid bar or casting. The impact piece or anvil block also breaks quicker than it should because of the quality of steel used, and the temper given it. This, of course, is being remedied. The corresponding part in the big machine drills lasts only five to ten shifts. In several places brass castings are used instead of steel, as now proposed. Naturally, brass will not stand one-quarter as well as steel. But the really vital parts of the machine have given no trouble—we refer to the valve, air chest, piston, air feed, column, etc. The dust-allaying device, because of faulty local workmanship, is wasting more water than necessary; yet a series of tests made recently indicate that even then the water consumption for a 3-foot hole is only about 1.½ gallons. As this water is used over and over again by the machines on the lower levels, and is also useful in allaying the dust created when lashing, this consumption in a 100-drill mine will prove inconsiderable.

"The inventors have been aware of these weaknesses from the very start, early last summer, and they assure us that the machines now on the way out will not be subject to the criticisms mentioned—*i. e.*, there will be no such faulty material or workmanship as we have mentioned. In this connection it is not out of place to remark that the design of the machine has not been criticised, even though it is such a radical departure from what we know as a machine drill. It must be borne in mind that the Robinson tests have not been run under the best conditions in regard to air pressures. Instead of the generally accepted minimum of 60 to 65 pounds pressure, which is as low as any rock drill can do really good work with, the Gordon drill worked with a pressure frequently under 50 pounds. While a so-called mining condition, at the same time it is certainly not altogether fair in a test run. Another reasonable criticism is that one boy was employed on every four machines to bring in and take out 80 drill steels weighing about 400 pounds. To charge this boy against the Gordon drill does not seem altogether right, as under average mining conditions he would not be employed. If we eliminate him, the Robinson trials, as reported officially, show an efficiency of over 4.2 holes per native, or 25 per cent. more than reported. Moreover, of the four white operators employed by the mine, at least one knew nothing about breaking ground, and would not have been kept on to run big machine drills. This criticism is based on the comments made by the various mining engineers who watched all four men.

"Turning to the natives employed, we find that out of fifteen at least a third never averaged under six holes per shift, and some drilled seven to eight holes per shift at such times as the pressure was what it should be—that is, 60 pounds and over. This only confirms the experience of big machine drill operators, in that selected boys are better than the riff-raff of the mine usually given the newcomer. Still another point borne out by the Robinson mine figures, and lost sight of, is that holes put down with the Gordon drill ought to break more ground by at least 20 per cent. than the ordinary hand-drilled hole. This is obvious when it is borne in mind that holes can be drilled 10 to 20 per cent. deeper than those generally put in by hand, and also at least 30 per cent. greater in area at the bottom. It is therefore not quite fair to consider holes or footage only. Fathomage is manifestly equally important. Given a reasonable air pressure, say 60 pounds, at the working face, eliminating the native carrying 80 steels twice a day, and placing the drill in charge of average good miners, it would not

be too much to expect at least five to six holes per native shift at the Robinson, the fathomage or rock broken being equal to that of six to eight hand hammer boys. That we are not very far out is confirmed by one of the officials, who has repeatedly remarked that the Gordon drill, in his opinion, is capable of putting down eight holes, which in fathomage would be equal to the work of ten hand hammer boys. We know of ten holes having been put in by a native, so eight is not too much to expect.

"In this connection we are reminded of a criticism made recently by the best-known rock drill agent here, to the effect that if the thousand big rock drills he had at work on these fields were kept track of in the way the Gordon drill was being watched and reported on, his business would fall off at least 90 per cent., if not altogether. This bears out our belief that the whole truth regarding the value of this Gordon drill will only become manifest after we have 500 or so at work on these fields. Once taken as a generally accepted factor, we will see more of the good points and less of the weak ones. We understand that on the basis of the Robinson trials the intention is to contract to keep the machines in repair for a fixed sum, the figure to be less than one-half of that now charged for the maintenance of large drills. The prevailing opinion is that this ought to be done very easily. We also learn that air consumption tests recently completed indicate that per inch of hole drilled the Gordon drill consumes only a third of the power required by the large machine drills; certain slight changes now made will reduce this still further. With these two factors insured, and discounting as indicated the results obtained at the Robinson mine, the real value of the Gordon stoping drill as a labor and money saver to the industry, is apparent.

## AIR AS A CONVEYOR OF HEAT AND MOISTURE

The transmission of heat or of moisture by means of a fan blower is closely allied with the process of ventilation. In an ordinary fan heating system all of the heating surface is massed at the fan, whence the heated air is forced through ducts to all parts of the building. For normal indoor temperatures, the outdoor air at zero, the incoming supply must range in temperature from 100 to 150 degrees, according to the rapidity of air change within the building. The air thus becomes a medium by which the heat is transmitted to distant points.

The process of drying is only an exaggerated case of heating in which the temperature to be maintained greatly exceeds that required in a well-ventilated room. A supply of air sufficient to change the volume once in 8 to 15 minutes in the ordinary structure is all that is necessary to meet the conditions of good heating and ventilation, but a supply equivalent to a complete change in the free spaces within the dry room 60 or more times per hour is required in the lumber dry kiln. The temperature therein will range up to 150 or more degrees. Owing to its greatly increased absorptive power the air at this temperature greedily takes up and carries away the moisture in the exposed surfaces. The method of application and the temperature to be maintained depend entirely upon the character of the material to be dried.

Glue and gelatine require low temperatures and ample volume. Knit goods in the piece are dried by internal application of heated air under pressure which distends the piece, the air escaping through the meshes. Cotton, wool and the like are spread upon beds formed by covering with netting enclosed boxes into which the hot air is discharged and from which it can only escape through the material above. The materials now dried by hot blast are legion: asbestos, blood, bricks and clay, clothespins, eggs, leather, malt, milk, gunpowder, hair, soap, stove linings, sweet corn, yarns and a thousand other products of our industries depend upon the process for their successful production.

## VACUUM FEATHER PULLER

It is stated that a new machine for plucking feathers from fowls promises to revolutionize the methods heretofore in vogue for this operation. The system is said to be along the line of the new vacuum apparatus now in use for cleaning carpets, etc. The freshly killed chick is put into the machine and suction does the rest and not a sign of a feather remains after the operation is completed. Whether a continuance of the operation would also skin the fowl is not stated. Former Governor Odell of this State is said to be interested in the invention.

# COMPRESSED AIR

Established 1896.

A monthly magazine devoted to the useful applications of compressed air.

W. L. SAUNDERS, - - - - - - Editor
FRANK RICHARDS, - - - - Managing Editor
L. I. WIGHTMAN, - - - - - Business Manager

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## GROWING ECONOMY IN COMPRESSED AIR PRACTICE.

The continued and rapid extension of the use of compressed air is a topic perhaps sufficiently familiar. The volume of compressed air used and the number of industrial enterprises in which it is now an indispensable agent have increased enormously even within the last decade; but more gratifying and more worthy of note is the improvement in air-compressing practice, the advance in the standards of performance as represented in the requirements of those who use the air compressed, and the success of the builders of air-compressing apparatus in satisfying these requirements. It happens that these matters have perhaps their best illustration and embodiment in our immediate neighborhood, and nowhere in the world in equal space is gathered such a collection of highly efficient and economical air-compressing machinery in actual and successful as in the city of New York.

There have been simultaneously employed upon the tunnel and railroad extension work entirely within the Greater City of New York and on the New Jersey shore directly across the North river, nearly 100 air compressors, with an aggregate free air capacity of 200,000 cubic feet per minute, a volume which would be represented by a cube with a side of 58 feet. The precise figures it is not necessary to give, but they are easily accessible, since it happens that all the compressors here spoken of, although selected and employed by a number of diffeffrent contractors, all fully informed as to the requirements and possibilities, and some of world-wide experience have been built by a single firm, who have complete records of these installations.

The gratifying fact in connection with these several plants is that they represent as a whole not only the most efficient and reliable, but also the most economically operated compressed air plants in the world. The driving of either of these tunnels or the excavating for the big railroad stations is of course in each case a temporary job, and it might easily have been assumed that it would not be wise or necessary to install anything but cheap machinery for the work. The machinery employed is, in fact, so cheap that in the saving effected in the cost of coal for driving them, as compared with the coal consumption of the usual compressing plants of ten or fifteen years ago, and all too numerous even to-day, they cost actually nothing, or entirely pay for themselves in a single year. This is not a random statement, but is based upon reliable information and careful computation.

It will be well to bear in mind the few essential points to be insisted upon as essential to economy in operating steam driven air compressors. Especially in these places are the conditions at the steam ends of the machines looked after, as here, after all, the greatest savings are effected. High pressure steam is used; the steam cylinders are compound and condensers are generally employed for all the steam used. The air-compressing cylinders also are compound or two-stage, with intercoolers between the cylinders, and aftercoolers are frequently employed. By these means high economy is effected both in the genration of th power at th steam ends of the machines and also in the employment of the power in the work of compressing the air, and cheap compressed air is the result.

## "AT THE WORKS"

By R. W. Raymond.

I borrow the title of this article from a book which has recently appeared in England, and to which, by reason of both its individual merit and its representative character I desire to call the attention of students of the "labor question." The literature of this subject, voluminous as it is, still fails to furnish the body of clearly observed and accurately recorded data which is necessary to safe inductions of general value. Magazine writers, bound to make impressive, picturesque and readable articles; partisans, seeking to advance their own theories or interests; sentimental philanthropists, to whom every hardship is a wrong, and every radical change of the social order is a remedy; politicians, regarding every wave of popular unrest as an aid to their own private navigation—until the tide changes; governmental committees of inquiry, tabulating assertions as if they were facts, and seeking to draw conclusions which will offend nobody; boards of arbitration, whose object is peace through compromise, rather than justice at any cost—these are too often the sources of our knowledge of the labor problem. Assuming them all to be sincere and honest (which certainly not all of them always are) they are still affected by the lack of quantitative measurements and the substitution of emphasis for weight in their statements of the fundamental elements of the problem. As a result, we are distracted by the advocacy of impracticable or ruinous remedies for non-existent, unavoidable, transitory or self-correcting features of the industrial situation.

What we want above all is *facts*. Are the poor really growing poorer, while the rich grow ever richer? Is the freedom of individual contract, protected and enforced by law, achieved by so many centuries of struggle and progress, a failure? Is socialism our only refuge from anarchy? These profound questions are daily treated as if they could be settled by eloquence, enthusiasm, or even brute force, without any thorough preliminary inquiry into the facts.

In this hasty and hysterical condition of public opinion, every calm and just, as well as sympathetic, report of the simple facts is most welcome; and to this class belongs the little book to which I have referred. Lady Bell, the author (already known in literature through several works of fancy and criticism, quite unlike this one), is the wife of Sir Hugh Bell, the son of Sir Lowthian Bell, and now the president of the Iron and Steel Institute, as well as lord lieutenant of the North Riding of Yorkshire. Those who know him need not be told how worthily his wide knowledge, genial sympathies and practical wisdom have enabled him to continue the work of his illustrious father. But, in my judgment, he needs no illumination, and suffers no eclipse, from his father's fame. I regard Sir Hugh Bell as one of the ablest men in England.

The wife of such a man may be (like Lady Lyell) his constant and coördinate co-laborer. Or, she may have her own distinct sphere of interest and influence. Lady Bell seems to have pursued a middle course. While reinforcing her husband in the manifold social duties of his position, she has made, for nearly thirty years, a close and sympathetic study of the actual conditions and lives of the operatives in the iron industry of Middlesbrough. Of this she now publishes the result. Her own description of the scope of her book is at once without any inquiry into the facts.

"I have not attempted to deal with the larger issues connected with the subject . . . with the great questions involved in the relations between capital and labor, employers and employed; I have tried but to describe, so far as it is possible for an onlooker to do so, the daily lives of the workmen engaged in carrying on the iron trade of this country in one of its centers of greatest activity."

Let us fervently give thanks for a piece of work so modest, yet so thorough and sincere. However tempted, I shall not, on this occasion, at least, mar my praise of it by using it in support of any views—even my own!—on the "labor question." All I would do now is to recommend the perusal of it to all honest students of the subject.

In successive chapters, the book treats of the Genesis of the Town; the Process of Ironmaking; the Expenditure of the Workman; Illness and Accidents; Old Age, Joint Households, and Benefit Societies; Recreation; Reading; the Wives and Daughters of the Ironworkers; Drink, Betting and Gambling. These topics are treated with keen perception and practical wisdom, as well as graphic descriptive power. Lady Bell must be recognized as of the select company who set forth "things as they are."—*Engineering and Mining Journal.*

## COMPRESSED AIR IN COAL MINES

The following interesting discussion which occurred at a recent meeting of the Engineers' Society of Western Pennsylvania, touches several topics of special interest to our readers. The subject under discussion at the beginning of the portion here reproduced was the long-distance transmission of air in the mine.

Mr. Lewis: We hardly ever get several miles in, but sometimes go as far as 10,000 feet. Following the pipe, it may be farther. We do not get the air in very successfully on long distances.

POWER LOSSES OF THE PORTABLE COMPRESSOR.

Chairman: I was in one of the mines in Wheeling some time ago, where a small truck, on the same main track, carrying a small electric driven air compressor, was used to supply air to the punching machine. This truck was carried within 30 or 40 feet of the puncher and moved about from place to place. This does away with the necessity of carrying the air through such long pipe lines.

Mr. Myers: That has been tried at different places, but the great trouble has been that you do not have water for cooling the compressor, and the air in the mine is charged with coal dust and it gets into the cylinders with the air and cuts them.

Mr. Lewis: It is a long way around the bush to first generate the electricity outside, take it inside, stand the losses on that, and also the losses which must necessarily occur with compression on a small scale, which increase quite rapidly as you go down the line. A big compressor working with compound steam and on compound air, thus cutting down the clearance loss to two atmospheres instead of five in the air cylinder, will run with very good economy. But the kind of compressor you could run around on a buggy and drive with a motor would be a very wasteful machine in itself, and driving it by a small motor through the wire would carry also all the loss of a small motor and transmission. This in addition to the point you mentioned, that it is a mighty poor place to run a compressor.

PLACE FOR THE COAL PUNCHER.

Mr. Schellenberg: I might say of the punching machine that it can work where the large electric machine could not work, that is, where the roof requires propping. An electric machine has got to be big nowadays or it is not economical. Such a machine requires about 12 feet free space to move one frame over the other, and the roof is in very many cases not good enough to stand such an open space unpropped. With a punching machine one can go between props just as a hand miner does. But all the coal is not mined by machinery. You can not mine out between rooms with machinery. So there is a disposition to leave rib coal in the ground—that is, to mine out what they can get with machines and let the rest go. It requires some hand mining to get all the coal. Then there are no machines in the coke regions. They do not undermine there; they blast from the solid face in narrow headings and rooms, and take out all the rest of the coal systematically in well-ventilated retreats.

Mr. Lewis: That coke region is rather a special condition, as they do not care how small the coal is.

Mr. Schellenberg: Machine-mined coal is never as large as hand-mined coal was or is, because it is slaughtered with the powder in heavy blasting.

J. M. Armstrong: It is also followed by a different class of miners than the hand miners of a number of years ago.

PUMPING A FLOODED MINE.

H. W. Myer: There was a unique occurrence related to me the other day relating to a case where a mine was flooded. The shaft was 150 feet deep and the mine was flooded as well as the shaft. They drilled a hole near the shaft 12 inches in diameter, drilled it down to and through the coal and about 150 feet deeper. Then they placed an 8-inch pipe in this hole without casing, and on the outside of the 8-inch pipe a 3-inch or 4-inch pipe, with an elbow extending up under and into the other about 2½ feet. This outfit was lowered into the hole to the bottom of the 300-foot hole. Then they connected a 3-inch pipe with a compressor temporarily set up and forced air into that pipe with 80 pounds pressure. They found that they could lift water out of that 12-inch pipe in a solid stream and lower the water rapidly, and did so until the water was lowered to the level of the coal; then it ceased to work. And it was very simple.

Mr. Myers: That is on the principle of what they call an air lift.

Chairman: I saw half a dozen discussions of the air lift in the *London Engineering*, I think it was, and nobody seemed to give even

Mr. Schellenberg: I can say confidently and a good theoretical discussion of it.
without any favor of any patentee that the easiest way to unwater a shaft on a large scale is to dip it out with boxes on the cages. There is no patent on it. It has been done in the anthracite regions as a steady way of pump-shaft work. I had the experience of unwatering a shaft that way and it worked very well. The boxes filled themselves from the bottom; and a little wooden lever was constructed to knock at the top, and lifting a gate on the box, to let the water out in a trough. It is relatively cheap and you can rapidly get and lift a full load of water.

Mr. Lewis: You have the advantage of lifting nothing but water; all the rest runs in balance.

Chairman: Does anybody know whether pulsometers have been used?

Mr. Schellenberg: They are very wasteful of steam, but will raise any kind of water and grit of any kind.

Mr. Myers: One of the troubles of the pulsometer is that when the pump sucks dry you have to reprime it; it will not pump automatically; at least, that is my experience.

VENTILATION.

Mr. Schellenberg: Compressed air is a very good adjunct even where they do use electricity. Anybody that has a compressor likes to hold on to it and use it for supplementary pumping in a small way; and it can be carried down to the very smallest. It can be used for a little automatic pump for unwatering a room in the bail hole instead of running a wagon in for bailing into. That cheap little air pump seems to have gone out of use. It is described best as a half-barrel beer keg, the bottom replaced by a performated copper bottom; on top is a balance for a valve that a float may open. When the water rises up inside it turns on the air. There is ⅛ inch of air only turned on that drives all the water through a little pipe to where it discharges itself by gravity, and then lets the valve seat itself; it may work day and night without any attention.

Then where entries are driven forward and there is compressed air in the mine, the steam pump can be followed up and used with air very favorably. And "sparking" electricity, it may be mentioned, can not be used in gaseous mines for any purpose, under present law.

## VOLUME OF AIR REQUIRED FOR VENTILATION

Theoretically a miner working under ground requires only 6.5 cubic feet of fresh air per minute for respiration, the absorption of moisture and the dilution of carbonic acid gas. This, however, assumes that all air after having been breathed is immediately removed without mixing with the surrounding atmosphere, a condition impossible to fulfill. Considering that the permissible vitiation of the air by the carbonic acid is 6 parts in 10,000, it will be found necessary to provide 66 cubic feet of air per minute to dilute and carry away the 0.8 cubic foot of carbonic acid produced per hour by one man. In this light it is evident that, although an average man at work breathes only about 0.43 cubic foot of air per minute, the amount necessary to carry away the gases given off is the really important consideration. Where explosives are used another element enters into the question, and proper provision must be made for this when determining upon the means for ventilating the workings. The problem is more difficult, of course, when all or a part of the workings are "blind"—that is, where a level is run in like a tunnel and has but one outlet. This makes any sort of natural circulation out of the question, and requires an extensive system of piping and fans. Not only must fresh air be continually supplied in sufficient volume, but the vitiated air must be removed.

## ATMOSPHERIC HUMIDITY AND BAD STEEL

My records show as a general observation that rails rolled in August and September, when there is so much humidity in the air, have developed split heads in greater numbers than those rolled during the winter season. The moisture per cubic foot of air in August and September is often as high as 5 or 6 grains, while it may not be one-half of that amount during the winter weather. The use of refrigerated air in which the moisture was reduced to a low limit would be preferable in the Bessemer converters. Each ton of metal converted requires approximately about 0.6 ton of air to be blown through it, and with a large percentage of moisture it affects the physical properties of the metal by a greater inclusion of gases. The practice of many mills with direct metal to use a jet of steam to regulate

the temperature of the blowing metal in lieu of scrap is decidedly objectionable and injurious to the resulting product.—*P. H. Dudley at Meeting of Society for Testing Metals.*

If the air were compressed to a pressure considerably higher than that required at the converter, then thoroughly aftercooled and drained and afterwards re-expanded to the blowing pressure, better results would seem to be assured. The apparatus and the power would, of course, cost something; but where do we get something for nothing?

## CORRESPONDENCE.

### FLOW OF AIR IN LONG TUBES

*Editor of Compressed Air:*

Mr. B. C. Batcheller, on "The Flow of Air in Long Tubes, with Especial Reference to Pneumatic Dispatch," in your issues from April to July, begins by developing a formula based on that of Prof. Unwin, who, he says, was the first to take into account the variations of the density of air with variations in its pressure. The development of this formula is a matter of considerable mathematical complexity and leads to a structure of formula which, while probably correct, is somewhat long and complicated.

It is probable that Prof. Unwin was not the first to consider the effect of the change in density with change in pressure. A series of articles was published on this subject in the *American Machinist* in July, 1899, by J. E. Johnson, Jr., in which he developed a simple formula by integration from the fundamental theorem of fluid friction, that the loss of head varies as the square of the velocity, as the density, as the perimeter of the pipe and as the length of the same for short lengths. Expressing the air flow in weigh or cubic feet of free air and its volume and density at a given instant as a function of the pressure at that instant, he integrated the differential equation expressing this condition and obtained the formula—

$$P_1^2 - P_2^2 = \frac{K V^2 l}{d^5}$$

The value of K was determined from the results of the Mount Cenis experiments to be approximately .0006, when the diameter of the pipe was expressed in inches, its length in feet and the quantity of air flowing in cubic feet of free air per minute, $P_1$ and $P_2$, being initial and terminal absolute pressures in pounds per square inch. He then constructed diagrams whereby any ordinary problem in the flow of compressed air could be quickly and easily solved. Mr. Johnson also pointed out that after this work was done he had found substantially the same formula, without the numerical coëfficient, worked out in Church's "Mechanics of Engineering," published in 1890. As the work of Unwin, at a much later date than this, was based on the formula for the flow of water, whose density does not vary, it seems that Church, and not Unwin, should be the one to receive credit for first developing a correct and rational formula.

In a subsequent article Mr. Johnson outlined a method of conducting experiments to test the accuracy of this formula by determining the actual form of the curve expressing the relation between length of pipe and pressure. He also called attention to the fact that the natural gas pipe lines in the region around Pittsburg, in which the pressure fell through very wide ranges and the flow was received into gasometers, furnished ideal conditions for a large-scale experiment on this subject.

Several years later there appeared in the *American Machinist* an editorial note to the effect that such a test had actually been made and that with the proper coëfficient for density its results agreed perfectly, to all intents and purposes, with the formula and coëfficient worked out by Mr. Johnson.

The object in calling attention to these facts is not only to do justice to Prof. Church, but to point out the extreme simplicity of the formula given above which has, at the same time, the advantage of having been found by experiment to be absolutely correct.

JOHN J. SMITH.

### FREE AIR CONTENT OF AIR RECEIVERS

*Editor of Compressed Air:*

In the article on "Air Brake Air Consumption," on page 4522 of your July issue, the capacity of a locomotive auxiliary reservoir is said to be about 3,900 cubic inches, and then it is stated that to charge one of these reservoirs to 110 pounds pressure requires about 29,250 cubic inches of free air.

I have tried to figure this out and I didn't come as near to it as I would like to. I did

it this way: $110 \div 15 = 7\frac{1}{3}$ atmospheres. Then $3900 \times 7\frac{1}{3} = 28{,}600$. Will you kindly tell me where I am wrong?

THEODORE J. BUTTER.

[You are not really very far out of the way in your method. If the absolute pressure of free air is 14.7, then the absolute pressure of air at 110 pounds, gage, is all the gage pressure in addition to the free air valve, or $110 + 14.7$, or 124.7, and that will correctly represent the contents of the reservoir at 110 pounds, gage, and the number of atmospheres will be $124.7 \div 14.7 = 8.48$. It must be remembered, however, that when compression begins the reservoir already contains 1 atmosphere, so that the volume to be supplied will be only 7.48. Then $3900 \times 7.48 = 29{,}172$, which is somewhat less than the volume as given in the article to which our correspondent refers.]

## TRADE PUBLICATIONS.

*Transformer Testing for Central Station Managers.* No. 8317. (Supersedes No. 8126). General Electric Company, Schenectady, N. Y. 42 pages, $5\frac{1}{4} \times 3\frac{1}{4}$ inches.

*Gas Engines for All Purposes.* The Fairbanks Company, Broome and Lafayette streets, New York City, send us their finely printed Bulletins Nos. 5, 5A and 11, describing respectively the Improved Horizontal Engine, Horizontal Portable Engine and the Outdoor Engine.

*Thermit Steel for Welding.* Goldschmidt Thermit Company, 90 West Street, New York City; 24 pages, 6 x 9 inches; numerous illustrations. This pamphlet describes the now well-known Thermit process and gives many details as to its application to specific cases, particulars of apparatus employed, actual consumption of Thermit for each job, etc. Perhaps the most remarkable exhibit given is in the wide range of adaptability to repairs in place, such as welding stern frame of steamship, patching broken cylinder, welding steel truck frame. Instead of wasting material as in ordinary welding this process supplies material as needed.

*Catalog No. 32,* recently issued by the Chicago Pneumatic Tool Company, deals chiefly with the "Chicago Giant" rock drill and its usual appurtenances. The book of 96 pages, with numerous half-tones, is a beautiful specimen of modern book-making. The text is clear and fully explanatory of the drills, showing details of construction, the special system of lubrication, etc. The "Baby Giant" and "One Man" drill also is described and illustrated, and several pages are devoted to air compressors, drill steels and other related matters. The address of the company is Fischer Building, Chicago, or 95 Liberty street, New York.

## MACHINERY READY TO SHIP WHEN PROMISED

"Don't ship our machinery yet; we are not ready for it; everyone is behind with their work."

This is the substance of more than one telegram to the Marine Iron Works of Chicago that recently came to our notice and brought out the following reply to our questions:

"Yes, we stick to our old text of 'lose an order rather than promise what we cannot perform' and no doubt we lose some business on that account, but I fail to see any sense or dollars in contracting for more than one can do. Buyers themselves are in part responsible for a practice that is becoming prevalent through insisting on a shipping date for special machinery from three to four weeks earlier than they need it, calculating that the builder will be that much behind his promise. As a consequence, many who make those promises are aware of the buyers' 'expectations,' and go him about four weeks better. We are up against just such a proposition right now where a concern who is making a special tool for us promised delivery in ninety days and we believed them, but that was five months ago and the tool not yet in sight. It takes long enough to build marine machinery without our adding or subtracting a single week, for it is all special work, built only to order and the experienced buyer is careful to anticipate his needs and allow ample time and thus be able to depend on a promise that is bona fide."—*Railway and Marine News, Seattle.*

In making rock excavations for building purposes in New York City and elsewhere, steam drills are frequently employed with temporary boiler installations. The Electric-Air drill not only renders the boiler absolutely useless for the purpose, but will do the work at a much lower cost without it, current being supplied by one of the big electric power companies.

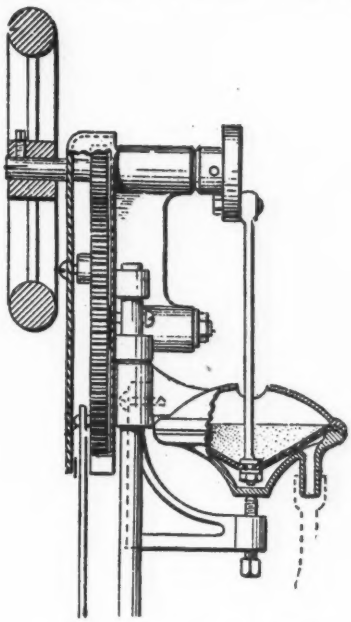
A very complete system of subways has been planned for the city of Chicago, more than $100,000 having been expended upon preliminary surveys, maps and plans, and when completed the rapid transit facilities of the city are expected to equal those of New York. It is understood that branch lines will extend to the west side, the Milwaukee avenue district, the north shore, Englewood, Hyde Park and Woodlawn. The company is known as the Chicago Subway Arcade and Traction Company, and a blanket franchise from the city is asked for.

## PNEUMATIC MASSAGE MACHINE

The accompanying cuts, which we take from the *Scientific American* of recent date, show a wood massage apparatus recently patented by

PNEUMATIC MASSAGE MACHINE.

Mr. Carl Rosen, Pennoger Sanatorium, Kenosha, Wisconsin. This is not an air compressor but a pulsator pure and simple, and the operation can scarcely be called massage, as it does not suggest a rubbing or even a kneading operation. The machine is operated by foot power, the crank being speeded up by gear and pinion. The diaphragm is vibrated very rapidly in the cup which causes rapid alternations of blowing and sucking in the connected tube.



SECTION OF MASSAGE MACHINE.

There are no valves. The mouth of the hose is applied to any part of the surface of the body and moved about at the will of the operator.

## HIGH TEMPERATURES

The fact that high temperatures are now daily obtained by means of the electric furnace, the oxy-actylene blowpipe and other artificial means causes an interest to be manifested in the actual temperature that is reached in melting refractory materials in the sun, whose temperature is the highest known.

Experiments with the optical pyrometer recently made are of interest as indicating the temperatures that are reached in certain operations and in the sun. These results are as follows:

| | |
|---|---|
| Porcelain furnace | 2498° F. |
| Glass furnace | 2552° F. |
| Open-hearth steel | 2795° F. |
| Melted platinum | 3236° F. |
| Incandescent lamp | 3272° F. |
| Arc lamp | 7410° F. |
| The sun | 13,712° F. |

## NOTES.

An Italian announces the invention of a perpetual motion machine operated by compressed air. We have no doubt that it will be a success wherever there is a perpetual supply of compressed air.

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The Compressed Air and Vacuum Cleaning Company, St. Louis, Mo., has purchased a site for a new plant for the manufacture of house-cleaning apparatus operated by compressed air. The expenditure will be $200,000 and 300 men will be employed.

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Mr. Frederick A. Waldron, Industrial Engineer, has opened an office at 37 Wall street, New York, with a branch office at 53 State street, Boston. Mr. Waldron, whose experience covers a period of twenty-nine years in manufacturing and engineering, will make a specialty of Profitable Factory Arrangement.

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The Vacuum Air Compressor Company, of Wauseon, Ohio, was incorporated recently with a capital of $500,000 by E. L. Barber, W. F. Moughter, O. W. Baker, F. G. Jaquet and C. C. Brigham. The company will manufacture a new air compressor in a factory to be built in Wauseon.

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A contemporary tells us that, according to the United States Geological Survey, there are over 1,200 mines under development in Oregon, giving employment to about 3,400 men; that's less than three men to a mine.

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One of the puzzling questions to the manufacturer is the general tendency among works superintendents to fail in keeping a sufficient supply of extra parts on hand ready for an emergency. An extra valve or other part of an engine or a compressor, say, which experience has shown to be likely to be demanded, does not cost much, while a few days' delay may mean thousands of dollars.

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There are now in Great Britain 119 engines of more than 500 horse-power each, the aggregate of these being 96,000 horse-power, or an average of 807. In Germany the number is 380; aggregate, 421,150; average, 1,108. In Belgium, 55; aggregate, 61,400; average, 1,116. Erhardt & Scumer have built one engine of 500 horse-power. This has four cylinders, 45x51 inches, running at 90 revolutions per minute.

## METAMORPHISM OF COAL.

At a small town called La Branca, in Sonora, Mexico, situated about sixty-five miles southeast of Torres on the Sonora branch of the Northern Pacific from Nogales to Guaymas, there is anthracite coal and natural coke. On looking over the outcrop, the only indication of coal is a gray clay, which on closer inspection proves to be ashes from burnt coal; below these ashes comes the natural coke, heavy in ash, although it will burn with a forced draft. Some of the veins are ten feet thick and extend down to nearly 100 feet; beneath the coke is anthracite coal of fine quality as far as analysis goes, but it slacks on exposure to the air. Apparently the coal measures were ruptured by a volcanic eruption, and the molten rock, on reaching the outcrop of the coal vein, burnt the coal to an ash where it had plenty of oxygen; when it did not have oxygen, it had the same effect as if placed in a coal-kiln. The pressure and heat changed the coal from bituminous to anthracite. Situated in this coal-field is the shaft of the old Tamorarra copper and silver mine, 500 feet deep in the eruptive rocks covering the coal measures. The copper and silver vein penetrates this eruptive, and on sinking the shaft, they encountered one of the coal seams, the coal being used in boilers for roasting, etc., in a chlorination plant.—*Mining and Scientific Press.*

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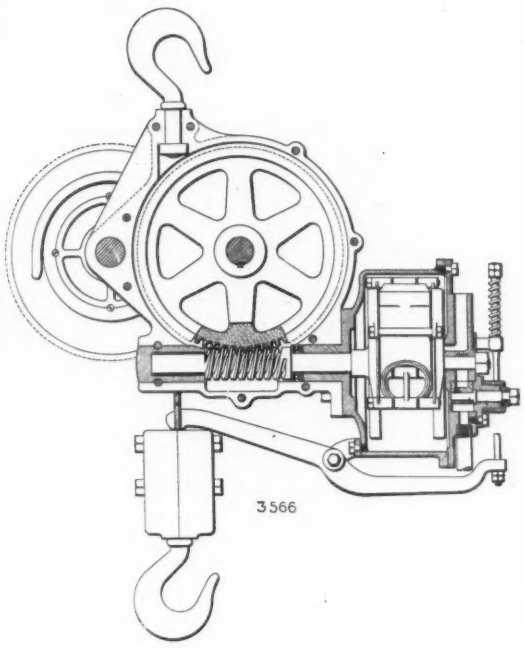
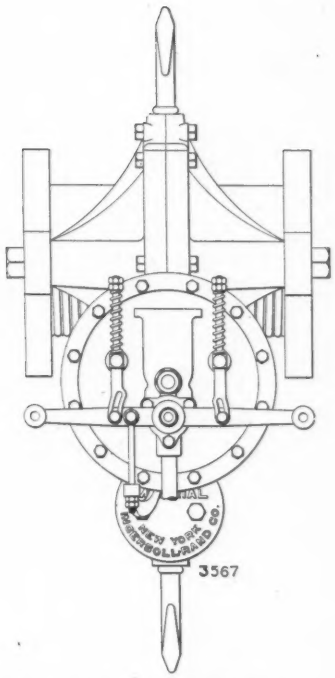
## THE IMPERIAL AIR MOTOR HOIST

The objectionable, and often prohibitory, features of the direct-acting air hoist are sufficiently familiar, and these are all conspicuous by their absence in the Imperial Air Motor Hoist here shown. It does not require a great height above the lift, and no more height for a high lift than for one not so high. The movement is perfectly controlled, both for hoisting and lowering, and the load is absolutely held at any point desired. There is no waste of air in filling long cylinders, the amount used at any time being only that required for the actual work.

The motor is a positive-action reversible air engine, with no dead centers and a practically uniform torque. It has no delicate valve mechanism requiring adjustment or liable to get out of order. It is wholly enclosed, dust-proof, splash oiling, with every bearing bushed and bathed in oil. The steel worm on the




motor shaft runs in an oil pocket, its thrust taken by a roller bearing, and meshes into a worm wheel of bronze, a pinion on the worm wheel shaft engaging the drum shaft gear. On the larger sizes of hoist there is an additional speed reduction; on all sizes the friction is the least possible, being minimized by the juxtaposition of the most suitable materials and the precise workmanship and finish of all working parts. The hoisting rope underruns a groove, which always permits an exact equalization of the two sides on the drum. The hook turns on ball bearings, the load may be turned in any direction without twisting the ropes and without its turning back. The action is steady and smooth, twelve of the hoists being used for hoisting flasks in one foundry. The hoist is made in five sizes, with capacities ranging from 1,000 to 10,000 pounds, using the ordinary air pressures. Built by the Ingersoll-Rand Company, 11 Broadway, New York City.

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It is reported that the Chilean Government will soon begin the work on a railway running north and south, which will be of great importance in the development of mines, especially in the north of the republic.

## LATEST U. S. PATENTS

JUNE 18.

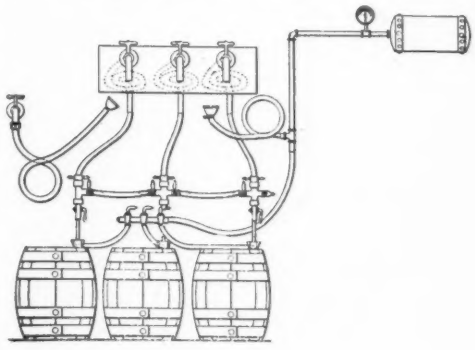
857,343. AUTOMATIC FLOW-REGULATOR FOR LIQUIDS AND GASES. JOHN H. GREGORY and WALTER W. JACKSON, Columbus, Ohio, and FREDERICK N. CONANT, Providence, R. I., assignors to Builders' Iron Foundry, Providence, R. I.

857,362. AUTOMATIC AIR-SIGNAL, AIR-BRAKE AND STEAM COUPLING. HERMAN C. PRIEBE, Blue Island, Ill.

857,477. PUMPING APPARATUS. GEORGE J. MURDOCK, Newark, N. J.

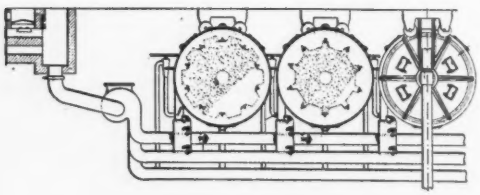
JUNE 25.

857,768. METHOD AND APPARATUS FOR RAISING LIQUIDS BY COMPRESSED AIR. ROBERT STIRLING, Surrey, England.



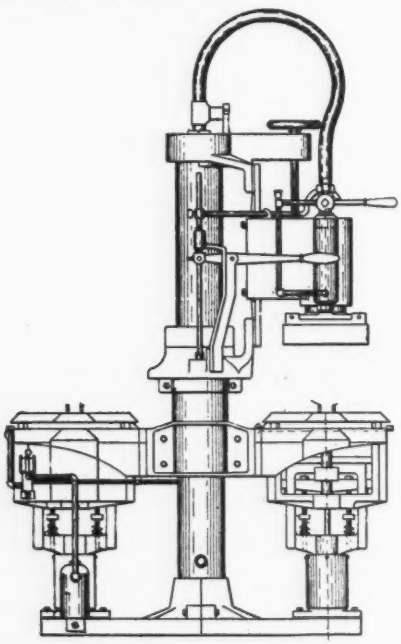
857,843

857,843. BEER-SERVICE APPARATUS. WILLIAM F. STARK, New York, N. Y., assignor of one-half to James English, New Haven, Conn.



857,945

857,954. PNEUMATIC MALTING AND PNEUMATIC DRYING APPARATUS. Frederick H. C. Mey, Buffalo, N. Y.



857,997

857,997. MOLDING-MACHINE. Frederick W. Hall, Camden, N. J., assignor of one-half to Howard M. Bougher and one-half to J. W. Paxson Company, Philadelphia, Pa.

858,039. AIR-PUMP. Frank E. Ten Eyck, Auburn, N. Y.

858,200. PNEUMATIC HAMMER. John C. McCavney, Superior, Wis.

*Claim.*—The hereindescribed *holding attachment* for pneumatic hammers comprising a cylindrical body for attachment to one end of the hammer barrel and having a partition provided with an air passage and ports leading therefrom to the interior of the hammer barrel and to the interior of said body, a piston in said body, a cap at the outer end of said body and a rod extending from said piston through an opening in said cap, for the purpose set forth.

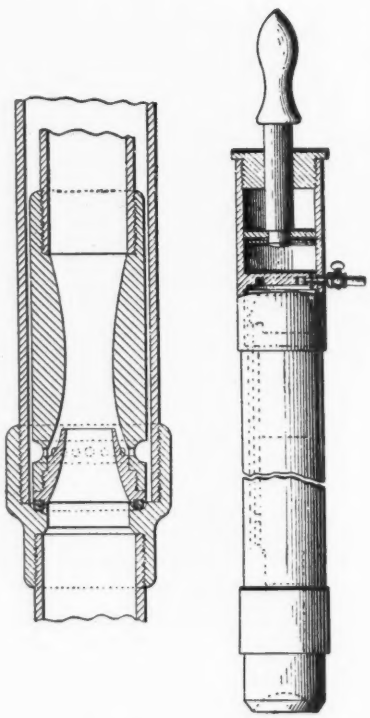
July 2.

858,398. FLUID-PRESSURE-OPERATED TOOL. Charles H. Johnson, Canton, Ohio, assignor to the Pittsburgh Pneumatic Company, Canton, Ohio.

858,442. GAS-SAVING OR PRESSURE-EQUALIZING VALVE. James Cowie, Chicago, Ill., assignor to National Gas Saving Company, Chicago.

858,467. AUTOMATIC DEVICE FOR STARTING MOTORS. Walter J. Richards, Milwaukee, Wis.

858,468. CONTROLLING APPARATUS. Walter J. Richards, Milwaukee, Wis.



857,768 858,200

858,469. FLUID PRESSURE SYSTEM. Walter J. Richards, Milwaukee, Wis.

858,470. FLUID PRESSURE SYSTEM. Walter J. Richards, Milwaukee, Wis.

858,471. CONTROLLING APPARATUS FOR PRESSURE SYSTEMS. Walter J. Richards, Milwaukee, Wis.

858,586. MEANS FOR SUPPLYING EXPLOSIVE VAPORS FOR OPERATING ROCK DRILLS. Otho C. Duryea, Brooklyn, N. Y., assignor to National Gas Drill Company, a Corporation of California.

858,588. WATER-LIFT. George V. Ellis, New York, assignor to the Ellis Company, New York.

858,592. BLOW-HEAD FOR GLASS-BLOWING MACHINES.

858,630. PNEUMATIC STACKER. James B. Schumann, Indianapolis.

858,635. REVERSIBLE MOTOR. Edward J. St. Croix, Seattle, Wash.

*Claim.*—In a fluid motor, a blade for the wheel thereof, said blade being approximately Z-shaped, thereby providing opposite recesses or impact portions on its opposite sides or faces.

858,640. METHOD OF BURNING FINELY-DIVIDED FUEL. George S. Wells, Chicago.

*Claim.*—The herein described method of burning finely divided fuel which consists in directing such fuel relatively radially into revolving air currents.

858,757. AMMONIA-COMPRESSOR. Frank A. Rider, Pittsburg, Pa.

858,793. RAILWAY-TRAFFIC-CONTROLLING APPARATUS. Clyde J. Coleman, Rockaway, N. J., assignor to the Hall Signal Company. (144 claims.)

858,911. PNEUMATIC CLEANER. Armand Richter, Garches, France.

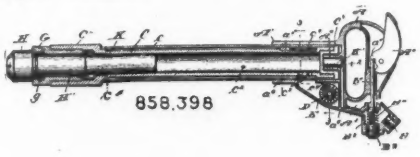
858,957. WATER-PRESSURE AIR-PUMP. Alton E. Cobb, Los Angeles, Cal.

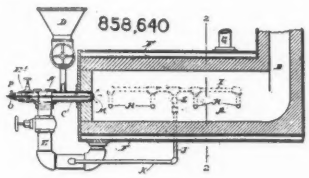
858,964. PNEUMATIC MIRROR-BRACKET. George W. Dayton and Sheridan P. Hotaling, King City, Cal.

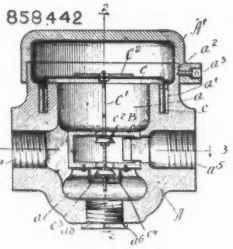
859,021. MEANS AND APPARATUS FOR PRODUCING HIGH VACUUMS. Frederick Soddy, Glasgow, Scotland.

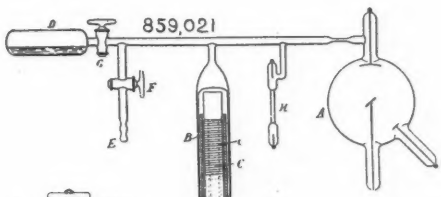
859,139. AIR-VALVE. Ira H. Spencer, Hartford, Conn., assignor to The Oregon Power Company, Hartford, Conn.

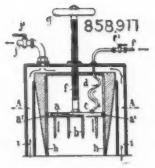
859,170. VACUUM PUMP. Joseph J. Mullaw, Philadelphia.

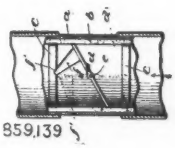


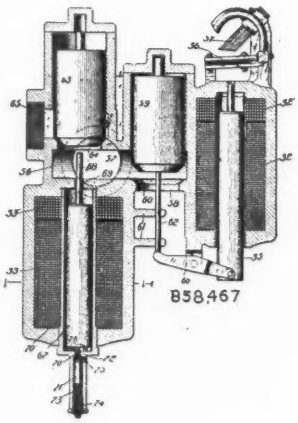



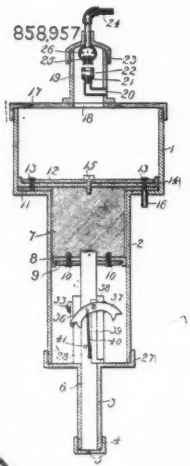



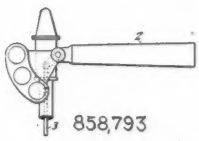



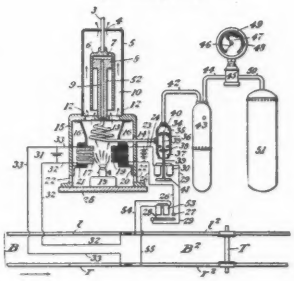



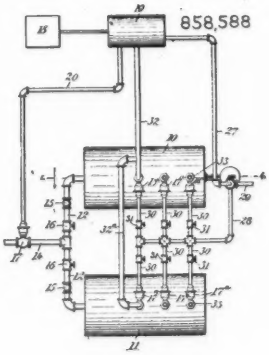



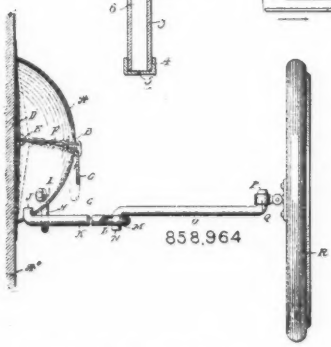



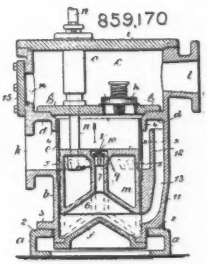





At present there is said to be more dynamite used in New York City than in any mining district in the United States. This is due primarily to the construction of the tunnels, of which about 38 miles are under construction, with 66 miles more projected. Since 1902 at least 2,000,000 tons of earth have been removed in underground work, in addition to about 3,500,000 tons removed in open-cut in connection with tunnel work. Many times this amount has been removed in excavating foundations for buildings not connected with the tunnel work.

---

Rock drills driven by air are necessary in mining operations and will remain so probably for years to come. For hard rock-boring there is no machine so universally used, and, consequently, as it is improbable that they can quickly be displaced by other classes of borers, every attention should be given to studying means of improving the present methods connected with their use. This is the more important inasmuch as in the utilization of power at the drill bit, the rock-drill is one of the most inefficient of common machines.

---

The pneumatic tube system in Philadelphia is being extended by the contractors, the Pneumatic Transit Company. At present the pneumatic system is in force from the main post office to the Bourse, the Pennsylvania and Philadelphia and Reading Railroad terminals, to Station S, Sixth street and Fairmount avenue, and Station O, Tenth street and Columbia avenue. The tubes to Station C, Nineteenth and Oxford streets, and Station J, Nineteenth and North streets, will be in operation by the last of August. The system will be extended to Station D, Eighteenth and Christian streets, and the Southwark station, Tenth street and Washington avenue, by November. A tube will also connect the main office with the new station in North Philadelphia.

---

Two unusual Chain Drives have recently been furnished by the Link Belt Company, both of them being of the Renold silent type. One installed to transmit 325 horse-power to refrigerating machinery in a brewery, consists of a pair of parallel chains on pulleys 14 feet apart, running at 1,100 feet per minute. The second drive runs a centrifugal pump from a horizontal turbine; its pulleys are 11 feet 7 inches apart, the speed is 1,755 feet per minute and the capacity of the chain is rated at 225 horse-power.

---

The last chapter is about to be written in the story of the Altoona cobbler who discovered the method of burning coal ashes that was to revolutionize the fuel industry. It is now declared that, allured by the promise of great wealth, he closed his cobbler shop and went gunning for big financial game. He is said to have been offered big prices for his patent and refused them. He failed to organize the stock company which he desired and is now reduced to the extremity of opening his cobbler shop again or starving.

---

A pumping engine of exceptional size has recently been ordered for the city of Nashville, Tenn. It will have a daily nominal capacity of 20,000,000 gallons of water, against a head of 390 feet, and will be operated by steam at a pressure of 160 pounds per square inch. The plunger speed is 240 feet per minute at 20 revolutions of the engine, the stroke being 6 feet. The duty guaranteed is 175,000,000 foot-pounds per 1,000 pounds of dry steam consumed by the engine and all its auxiliaries. The total horse-power required will be about 1,550. The engine is being built by the Allis-Chalmers Company.

---

Advertising has begun for bids for constructing Ashokan dam for the new water supply of the City of New York. This will be one of the most gigantic dams ever constructed, only the Assouan dam, in Egypt and Croton dam approaching it. The location is in the southern part of the Catskills. The dam will be 220 feet high, 196 feet thick at the base and 26 feet at the top and 1,000 feet long. The cost will be at least $10,000,000. There will be 2,055,000 cubic yards of earth excavated, 425,000 cubic yards of rock excavation, 7,055,000 yards of refilling and embanking, 210,000 yards of soil required for surface dressing, 1,100,000 barrels of Portland cement for the dam, 280,000 cubic yards of concrete masonry, 530,000 cubic yards of Cyclopean masonry, 64,000 yards of concrete blocks, 125,000 cubic yards of face dressing for concrete, 95,000 cubic yards of dry rubble paving, 929,000 pounds of cast and wrought iron and nearly a million feet of lumber.

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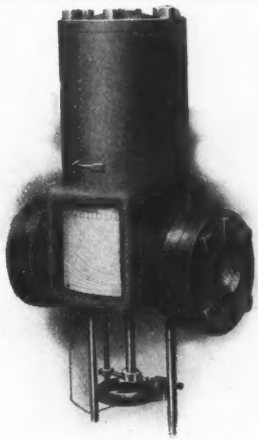

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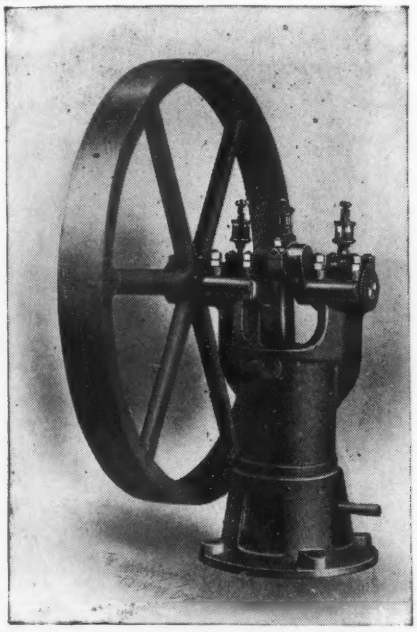

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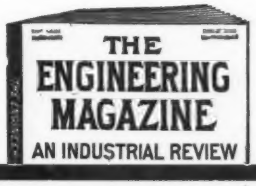


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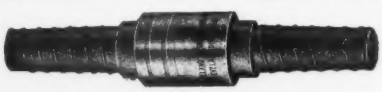

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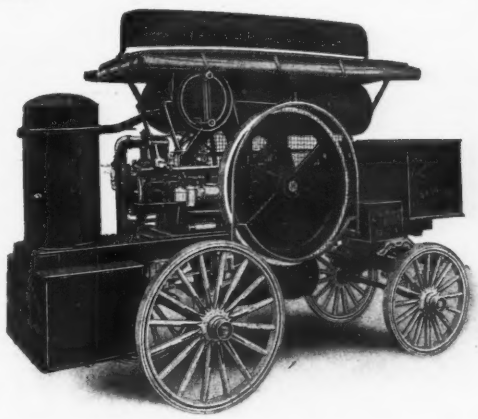

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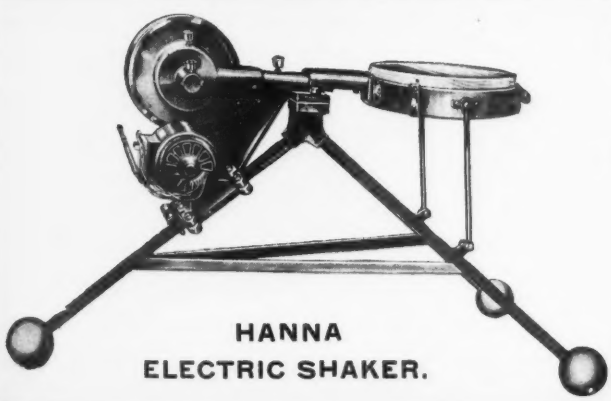

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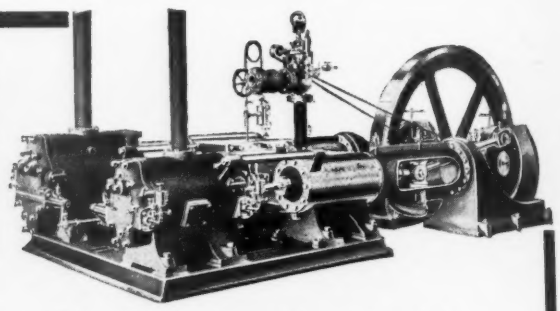

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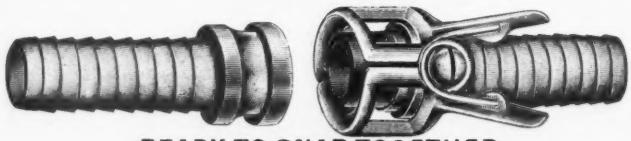

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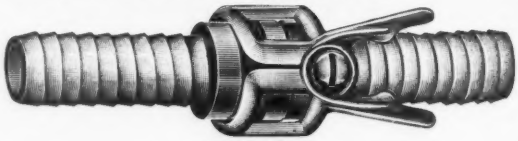

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